Research with Modeling of Temperature Regime of Electronic Components in Middle and Deep Vacuum

Asoc. Prof. Dr Eng. Ivan Evstatiev[1], Dr Eng. Dimitar Dimitrov[2]

Abstract: **A research of the parameters influence of an electronic model that works in conditions of middle and deep vacuum. We discus the changes in the energy characteristics. Using a physical model, that describes the processes in the system. Using this model is we develop a software model on a personal computer and we analyze the changes in the physical model. A research of the power consumption, the mass, the surface, the environment temperature, the blackness etc. The results are given on following graphics.**

Keywords: **mathematical model, electronic components, vacuum**

The valuation of the influence of the parameters of an electronic module and the parameters of the environment in middle and deep vacuum is a precondition of choosing the rights regimes of module power loading and a regime of backing of its parameters in the established regime.

The research is based on a given algorithm [1]. Using this algorithm a software for a personal computer has been made. We made the research using this software. The software gives an information window on the computer screen. This window consists of graphics zone, key zone for starting the four graphic conditions and zone for giving the parameters used in the research.

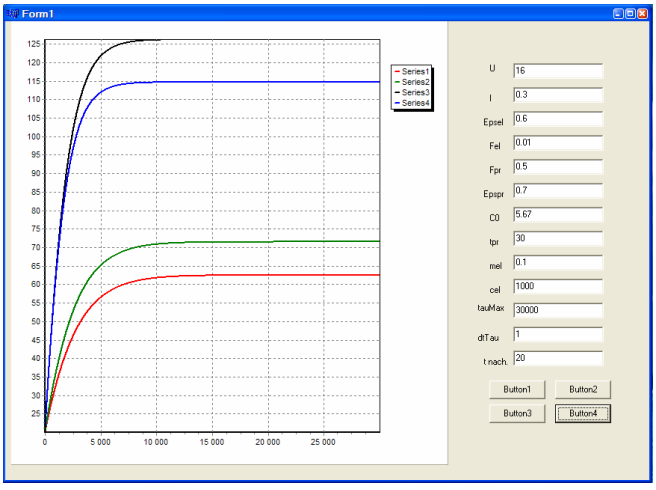

Figure 1. Software's information window

Using simultaneously giving of the four graphs we can compare four different regimes of operation.

I. Research Methods

Power consumption over the caloric effect of the module.

We presume that all consumed energy transforms into heat [1]. We test the influence of the power supply voltage and the current consumed over the caloric effect of the module. We use two power supply voltages and two different currents consumed – graphic 1 – 5 V/0,1 A, graphic 2 – 5 V/ 0,2 A, graphic 3 – 10 V/ 0,1 A and graphic 4 – 10 V/ 0,2 A.

Investigation of influence of the level of black of the electronic model and the environment.

We give four levels of black of the electronic module E_{psel} = 0,2; 0,4; 0,6 and 0,8. We change the levels of black of the enclosure too (E_{pspr} = 0,2: 0,4: 0,6 and 0,8).

Research of the influence of the radiation surface of the module and the enclosure.

We change the surface of the electronic module (F_{el} = 0,01; 0,02; 0,03 and 0,04 m^2) and the enclosure (F_{pr} = 0,5; 1; 1,5 and 2 m^2).

To analyze the mass action of the module and its thermal capacity coefficient they change as follows (m_{el} = 0,1; 0,2; 0,3 and 0,4) and (c_{el} = 1200; 1400; 1600 and 1800 $J.kg^{-1}.K^{-1}$).

II. Results

Research of the power consumption over the caloric effect of the module.

According to the methods the received dependences are shown in figure 2.

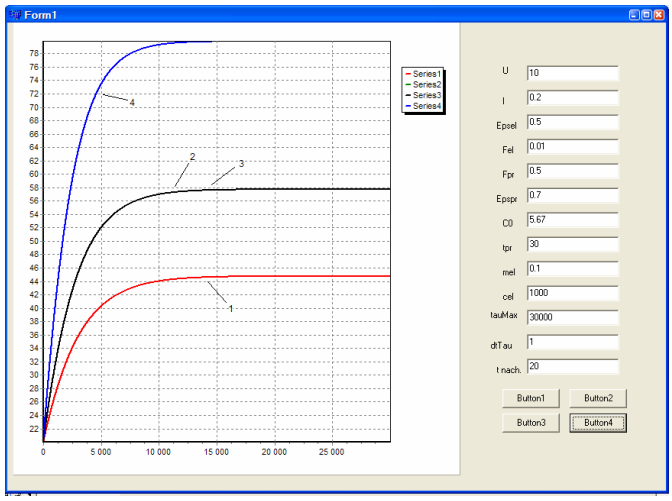

Figure 2. Power consumption influence over the caloric effect of the module

[1] Ivan Evstatiev, University of Rousse "Angel Kanchev", Faculty of Electro technique, Electronics and Automatics. e-mail: ievstatiev@ecs.ru.acad.bg, address: Bulgaria, Russe 7017, ul. "Studentska" 8.

[2] Dimitar I. Dimitrov, Ph. D., University of Rousse and the Faculty of Communication Technology, Technical University – Sofia, Kliment Ohridski 8, 1000 Sofia, Bulgaria, e-mail: ddim@tu-sofia.bg

As you can see from the figure above the temperature change is proportional to the brought energy of the module. The time needed to reach the established regime is about 2,7 hours practically does not depend on the energy.

Figure 3 gives the influence of the level of black of the module over the thermal regime is given in figure 3.

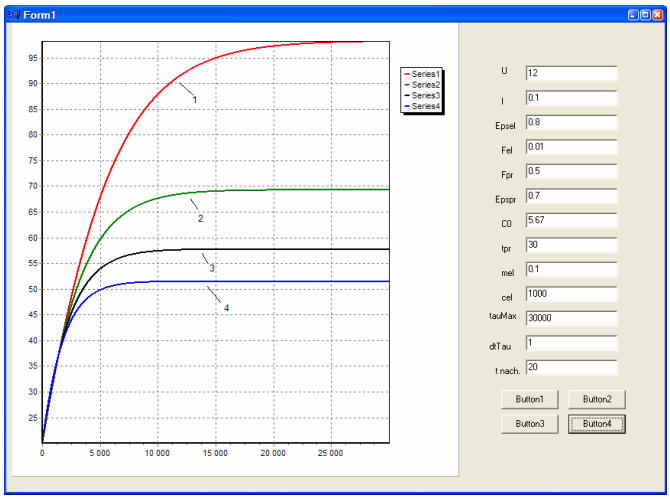

Figure 3. Influence of the value of black of the module over the thermal regime

Using the dependences we can generalize that increasing the value of black of the electronic module, almost exponent decreases the module temperature after reaching the established process. Increasing the value of black of the electronic module, the time for reaching the established regime decreases.

The result of the investigation of the influence of the level of black of the environment is given in figure 4.

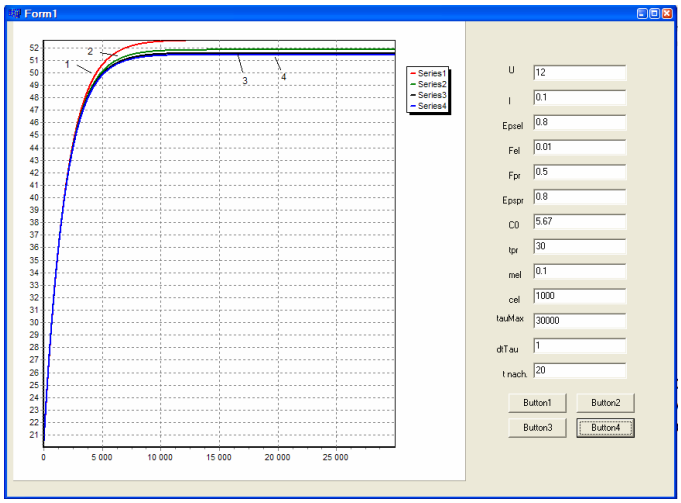

Figure 4. An influence of the level of black of the environment over the temperature regime

The value of black of the environment practically does not influence on the thermal regime and the dynamics of its changes.

The influence of the radiation surface of the module is shown in figure 5. The influence of the environment in figure 6.

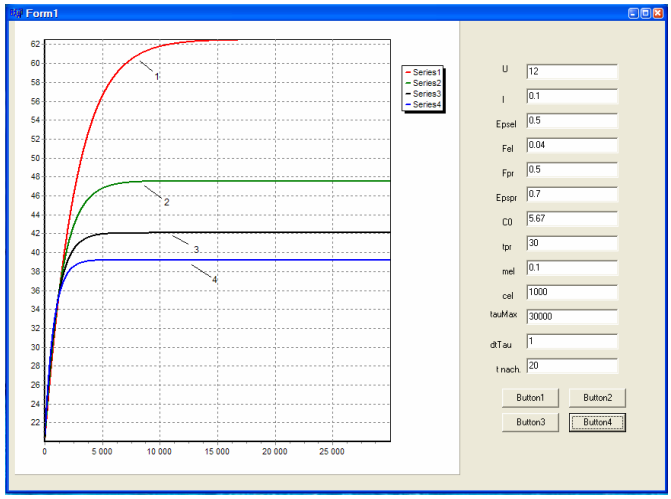

Figure 5. The influence of the radiation surface over the temperature regime

As shown in figure we can assume that increasing the radiation surface of the electronic module decreases exponent its temperature. Using module with bigger surface we reach the established regime faster.

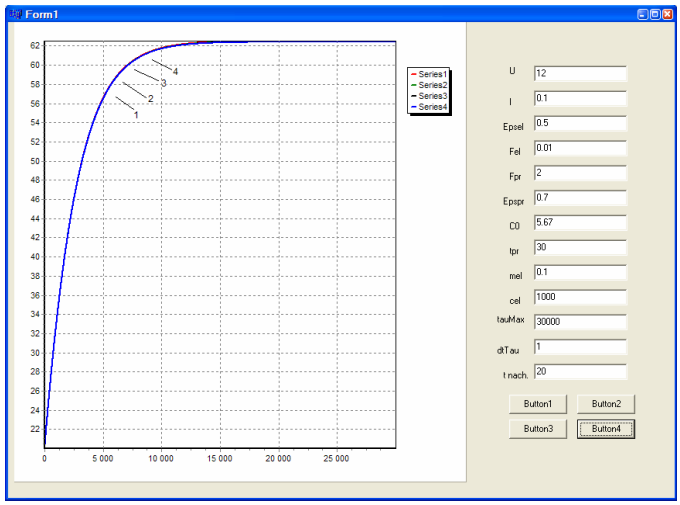

Figure 6. The influence of the radiation surface of the environment over the temperature regime

The radiation surface of the environment does not effect on the thermal regime and over the dynamics of changing module's temperature.

The analyses of the influence of mass of the module is shown in figure 8. The thermal capacity is given in figure 8.

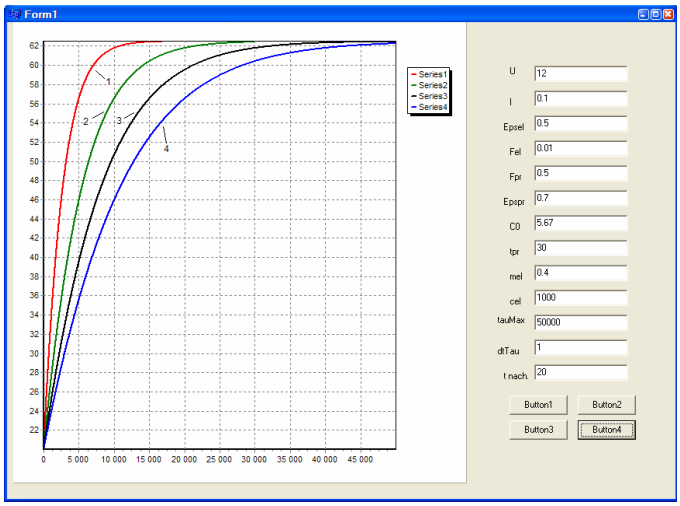

Figure 7. The influence of the module's mass over the thermal regime

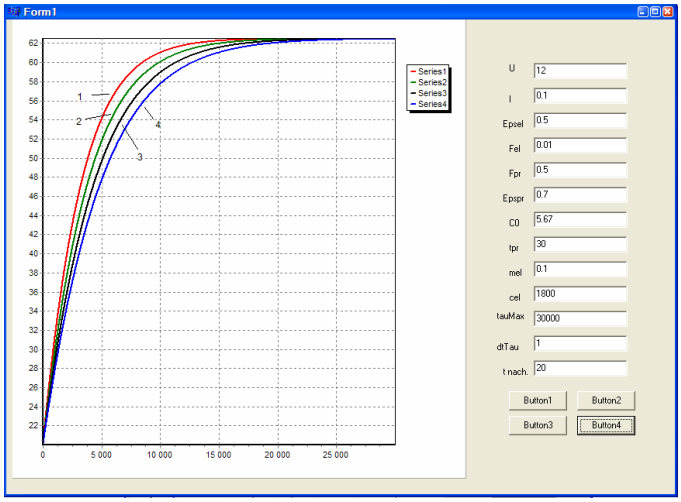

Figure 8. Influence of the thermal capacity coefficient of the electronic module over the temperature regime

Increasing the module's mass increases the time constant of the process and increases time for reaching the established regime.

Changing the thermal capacity coefficient of the electronic module changes the dynamics of the process.

III. CONCLUSIONS

The following parameters influence electronic module working in middle and deep vacuum conditions:

- Increasing power consumption increases exponentially its temperature
- Increasing the level of black of the electronic module and its radiation surface exponentially decrease its temperature
- Changing the electronic module mass and its thermal capacity coefficient change the dynamics of temperature changes, but do not change the temperature of the established regime
- The level of black of the environment and the radiation surface effect weekly over the heat exchange

REFERENCES

[1] Evstatiev I., D. Dimitrov, Temperature Sweep Modeling of Electronic in Medium and Deep Vacuum Conditions, ICEST 2004, Bitola, Macedonia, 16-19 June, 2004.