The summary of doctoral thesis:

CONTRIBUTIONS TO THE STUDY OF HEAT TRANSFER IN HEAT EXCHANGERS WITH MICROCHANNELS

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By doctoral thesis with the title "Contributions to the study of heat transfer in heat exchangers with microchannels" we proposed to study, analysis and accomplish the following objectives:

- theoretical studies regarding the main construction types of heat exchangers;
- design and implementation of an experimental cooling of microprocessors;
-experimental research on the properties of the agent;
- design and implementation on a stand to determine the efficiency of heat exchangers with fins;
- validation of theoretical results and experimental research.

Way of achieving goals is presented in seven chapters listed below.

First chapter, **The actual study of the construction of heat exchangers,** is the current presentation, at the national and global heat exchangers. State constructive main types of heat exchangers, highlighting the advantages of each type and area of use. In the last part of the chapter are presented for the construction materials used for heat exchangers. For heat exchangers used in general the following materials: steel (carbon, refractory alloy, anti-corrosion, stainless, etc..) iron, aluminum and aluminum alloys, copper and its alloys (brass and bronze), plastics and glass. Aluminum is resistant to the action of many aggressive environments. Has the advantage that it can obtain compact heat exchangers with flat surfaces with different types of ribs.

The second chapter, **Theoretical considerations on the heat transfer**, has fundamental modes of heat transfer and heat transfer laws.

It highlighted the heat transfer under permanent regime: major objective pursued in the analysis of heat is the temperature field in an environment, and obtain expressions for calculating the coefficients of heat exchanger and heat transfer in the stationary regime, in many practical situations, heat transfer takes place under transient temperature and heat flow sizes are variable in time. During transfer to corpse temperature changes continuously, while adjusting and thermo-physical properties of the corpse and the boundary layer, sizes influences first transfer coefficient α and other parameters considered constant, which occurs in the general equation of conduction.

Ambient temperature can also be changed during the transmission of heat. In some cases, even initial temperature at the initial time can not be considered uniform, but may have a complex variation. All these can lead to the impossibility of integrating the general equation of thermal conduction.

Then it is shown to intensify the processes of heat transfer, outlining three major ways to increase: the intensification of heat transfer in relation to the generation of entropy processes to increase heat transfer coefficient by increasing global trade and intensification of heat transfer processes using oscillations.

In the third chapter, **The influence of hydrodynamic factors on heat transfer**, are presented hydrodynamic factors that affect heat transfer and apparatus and methods used in the experiment for determining properties of fluids used for heat. Describes different types of thermometers used in the experiment for measuring temperature, then is a method of measuring pressure, using manometer with U tube and a method for measuring the flow and viscosity.

It made a comparison between the behavior of Newtonian fluid behavior and fluid flow in Nenewtoniene.

Then, are reviewed the most widespread use in heat exchangers of heat, indicating that the water meets most conditions required of a perfect heat.

Chapter four, **Section influence the flow**, is presented theoretical and experimental research on the influence of flow section. Chapter begins with the presentation of the factors that influence the flow and the establishment of flow regimes in heat exchangers is done then a geometrical description of the systems presented microchannels. Methodology is presented for calculating the Reynolds number and Nusselt number for determining the type of flow and a series of graphs of variation depending on the flow.

Chapter five, **Pilot installation**. In the first part of the chapter is presented with the experimental heat exchanger with fins. It shows how the implementation and operation of the cooling with heat exchanger fins in explaining the role of each component, the steps of determining the characteristics of heat exchanger with fins, the preparation of the stage and making measurements.

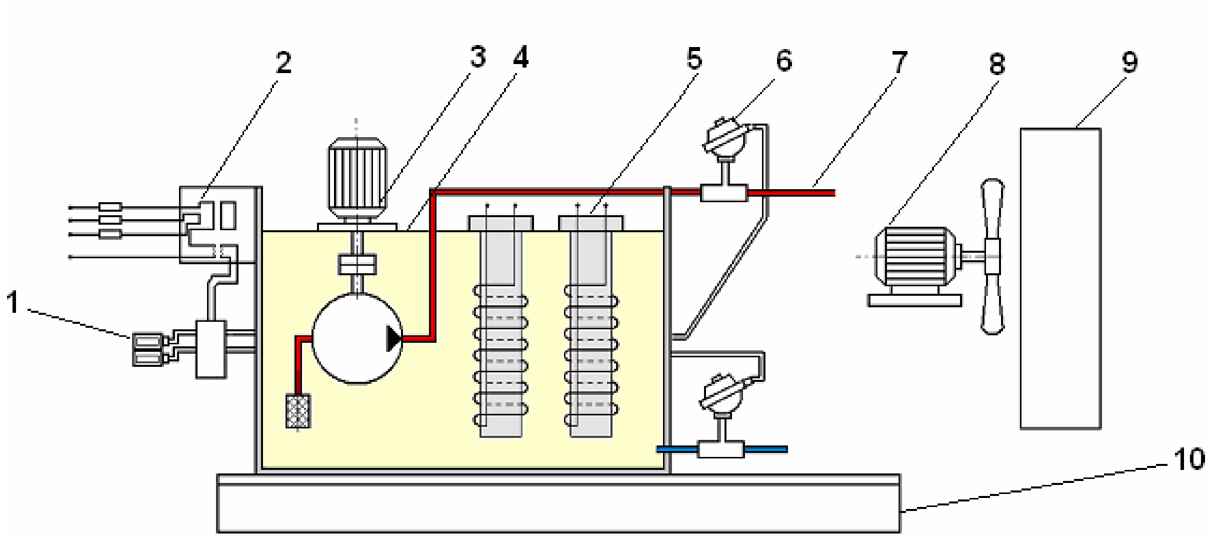


Fig.1 Experimental installation for determining the effectiveness exchangers heat with fins

1-digital thermometers, 2 - electrical panel, 3-pump, 4-tank of liquid 5-electrical resistors; 6 - TTC termocuplu Iron-Constantan 7-recirculation ducts; 8-electric motor with fan; 9- heat exchanger, 10 - support;

In order to determine the efficiency of operation of heat exchangers with fins was tried and a cooling fluid with a transformer oil.

To obtain conclusive data behavior of heat exchangers, a model plant for cooling oil were adapted and tested two types of heat exchangers, a first heat exchanger with fins, type A and the second being heat exchanger with fins, type B. Figure is observed in the composition of the cooling system and a series of measuring devices used to determine the cooling parameters.

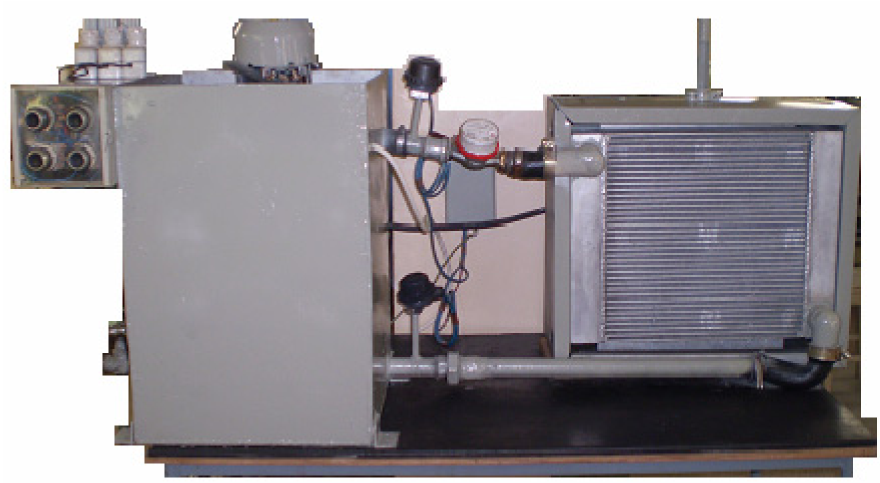


Fig. 2 View of the experimental installations of the heat exchanger with fins

Data recorded in carrying cooling process were stored in the determination and functional parameters of the system and using specialized software have made calculations to obtain the final data. The data obtained were processed using Microsoft Excel software, achieving the ultimate in a series of graphs of variation of process parameters. Measurements were performed for a number of ten distinct values of the working fluid temperature, by actually going through the entire cycle of measurement.

Starting from the conclusions drawn from theoretical studies and practical studies, proposed a model plant experimentally cooling microprocessors with a heat exchanger with microchannels using water as a heat softened and control parameters of the technological process.

In order to determine the effectiveness of heat exchanger with microchannels, air temperature was measured transmitted fan surface useful exchanger; nine points separate pyrometer through an electronic beam type laser OPTRIS LS.

In order to measure and record storage, to appeal to manual recording data value speed measuring range module to read flow stroboscope, value of the environment temperature, value of fluid imbalance in the tube U corresponding falling pressure, and automatic recording using two computer software specialist, one to measure the thermal parameters of the laser pyrometer, temperature and type OPTRIS software to determine the operating parameters of the computer type EVEREST.

To determine the rate of flow of the fluid and thus the liquid coolant flow in recirculation plant used a system of measuring the rotor speed palettes module measuring flow, which consists of a lamp stroboscopic and measuring device type STROBOSCOP N2601.

The fall of pressure is taken from the circuit input and output of the exchanger through two rivets T and two pairs of plastic hoses.

In order to determine certain functional parameters of heat exchanger cooling system was equipped with the following elements:

- două termometre digitale tip modul AD-TERMo4 cu traductoare (senzori) tip termometru dig. -25/+100C;
- two digital thermometers AD-type mode with TERMo4 transducers (sensors) type thermometer dig. -25 / +100 C;
- a transmitter for determining the pressure fall at the entrance and exit cooling agent in the heat exchanger consists of a U tube, inside which are the same coolant and in the state of rest in equilibrium, it can be seen on the scales write on a paper with millimeter.

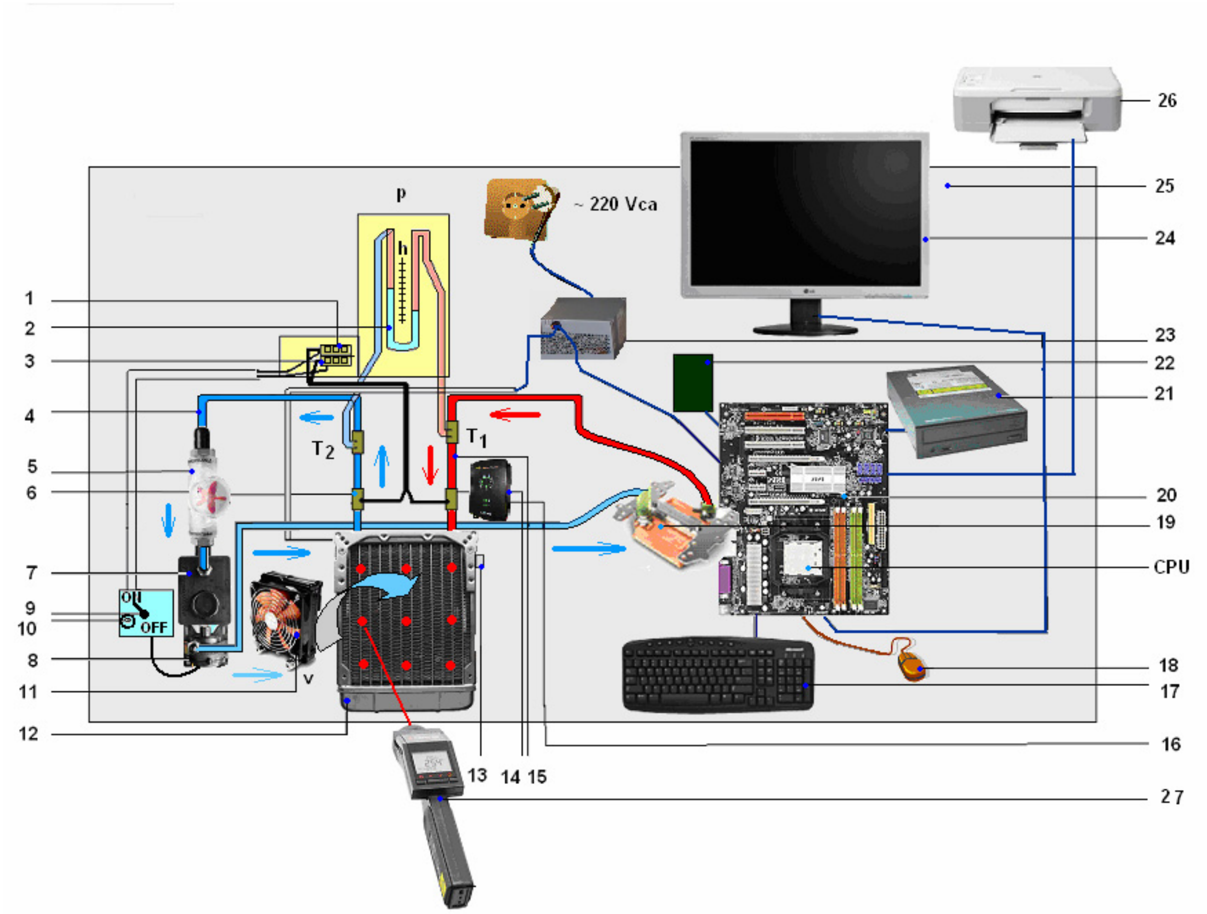


Fig. 3 The experimental installation:

1 - digital thermometer T1, 2-U pressure tube, 3 - T2 digital thermometer, 4-tube plastic for recirculation liquid cooled, 5 - how to control the flow, the 6-probe temperature T1, 7 - the reservoir of liquid; 8-hydraulic pump, 9 - on-off button, 10-ponențiometru for hydraulic pump flow adjustment, 11-fan radiator for cooling, 12-aluminum radiator for cooling the cooling agent, 13-potentiometer to adjust the fan speed, 14-probe temperature T2, 15-fitting-up, 16-source (tester) for supplying cooling system, 17-keyboard, 18 mouse, 19-block for cooling microprocessor CPU Water Block, 20 motherboard-21 CD-rom 22 hard-disk, 23-board power source for the 24-monitor digital, 25-plate cooling installation support; 26 - Laser Printer, 27-pyrometer Laser.

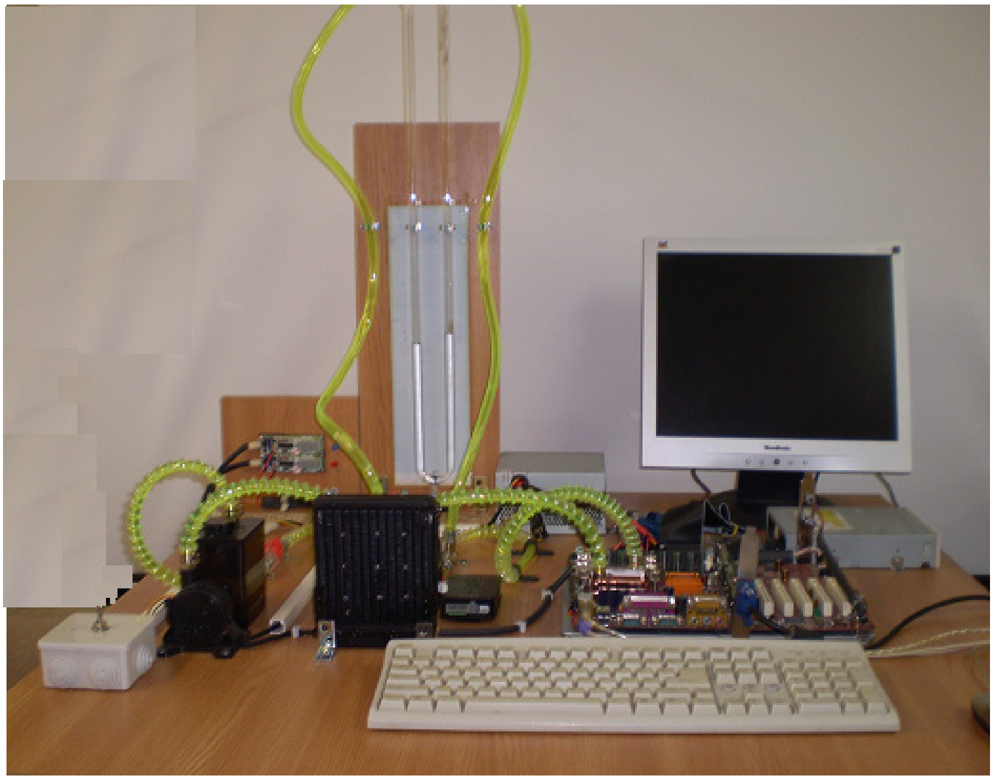


Fig.4 Front view of the experimental installation of cooling microprocessor

Chapter six, **Processing experimental results, relationships and graphical computing.**

By browse through all the possible modification of thermal regimes in heat exchangers adapted for the experiment was obtained a series of data and characteristics were analyzed and synthesized into a series of graphs of variation and a package of calculations that established the effectiveness of the two types of heat exchangers with fins.

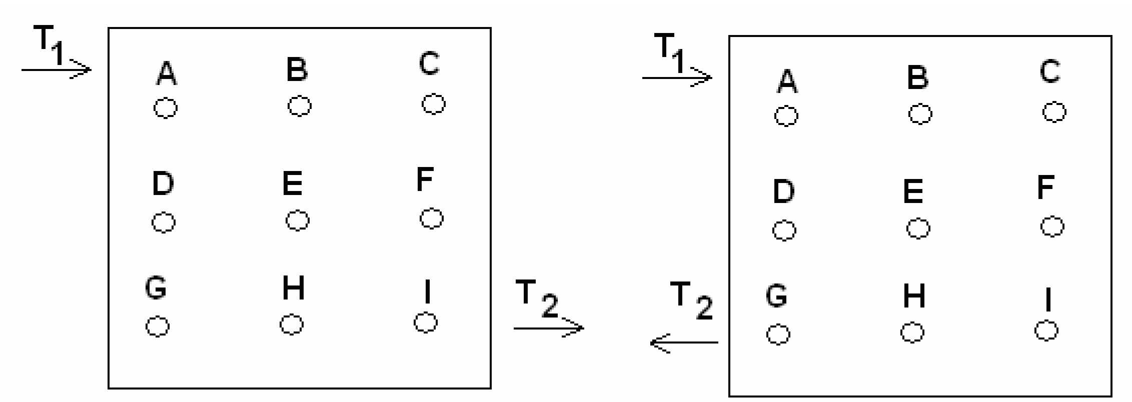


Fig.5 Representation measuring points on the surface of heat exchanger with fins type A and type B

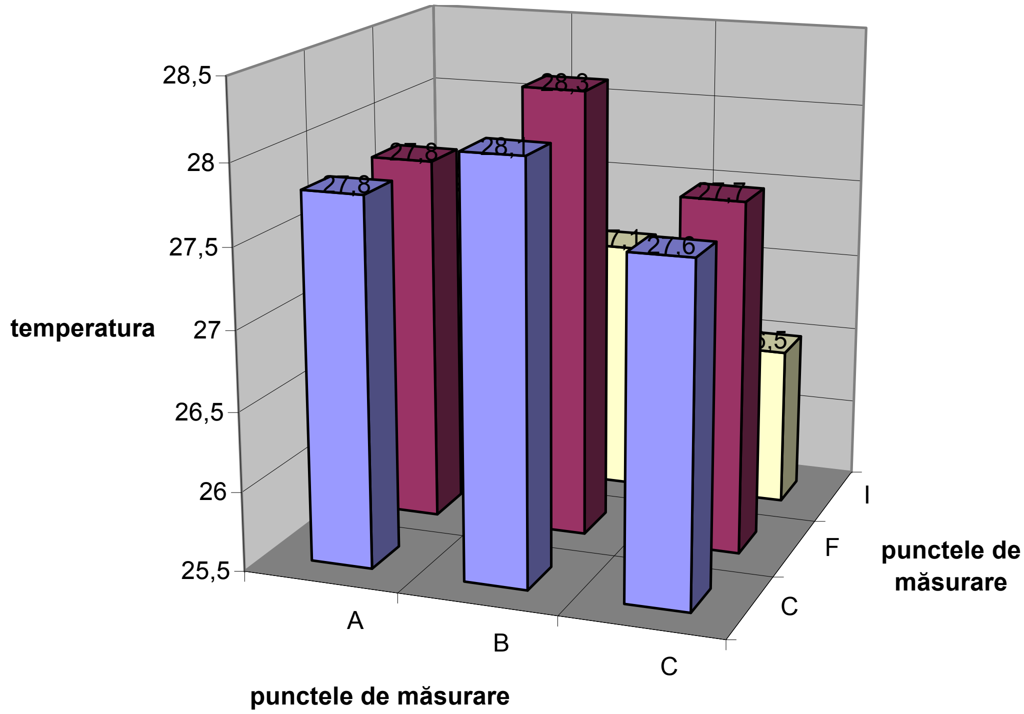


Fig.7 The variations of temperature in nine-point of measurement

There were variations in the temperature graph in the nine points of measurement for the ten schemes amending the working fluid temperature and temperature variations at the entrance and exit from the heat measured by electronic thermocouple and fever thermometers.

Studying the two data sets, variation in temperature on the heat exchanger and the variation speed fan blowing air is observed that where the maximum temperature values are at the point E, the exchanger, air blowing speed fan are minimum values.

As a partial conclusion, one can say that because the exchanger is ventilated areas are uneven surface exchanger where the temperature becomes higher than the neighboring points (the exchanger).

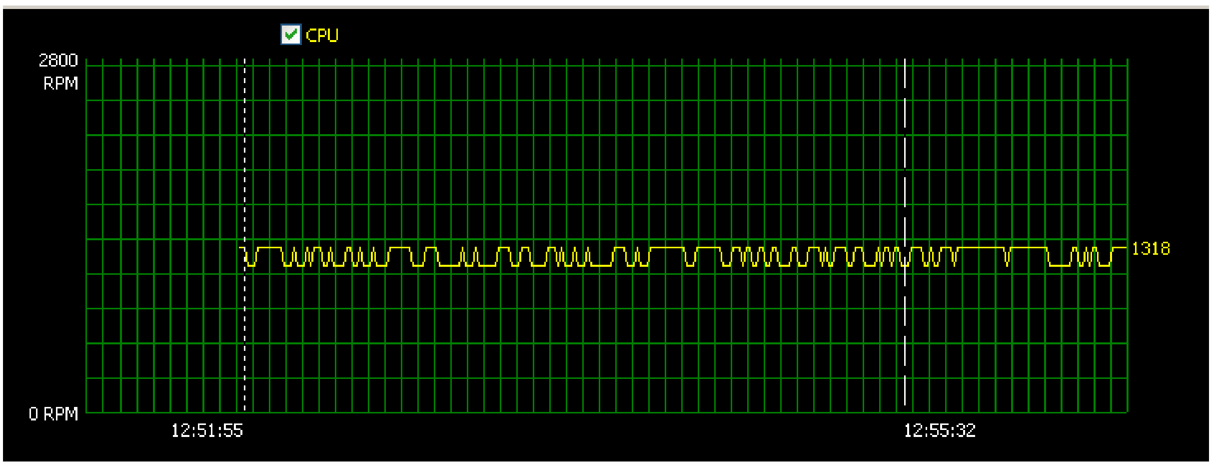


Fig. 8 The variation of fan speed for the operation I:

Has represented the variation of temperature input in heat exchanger with microchannels, simultaneously with the variation of temperature surface of heat exchanger with micochannels in the nine selected points

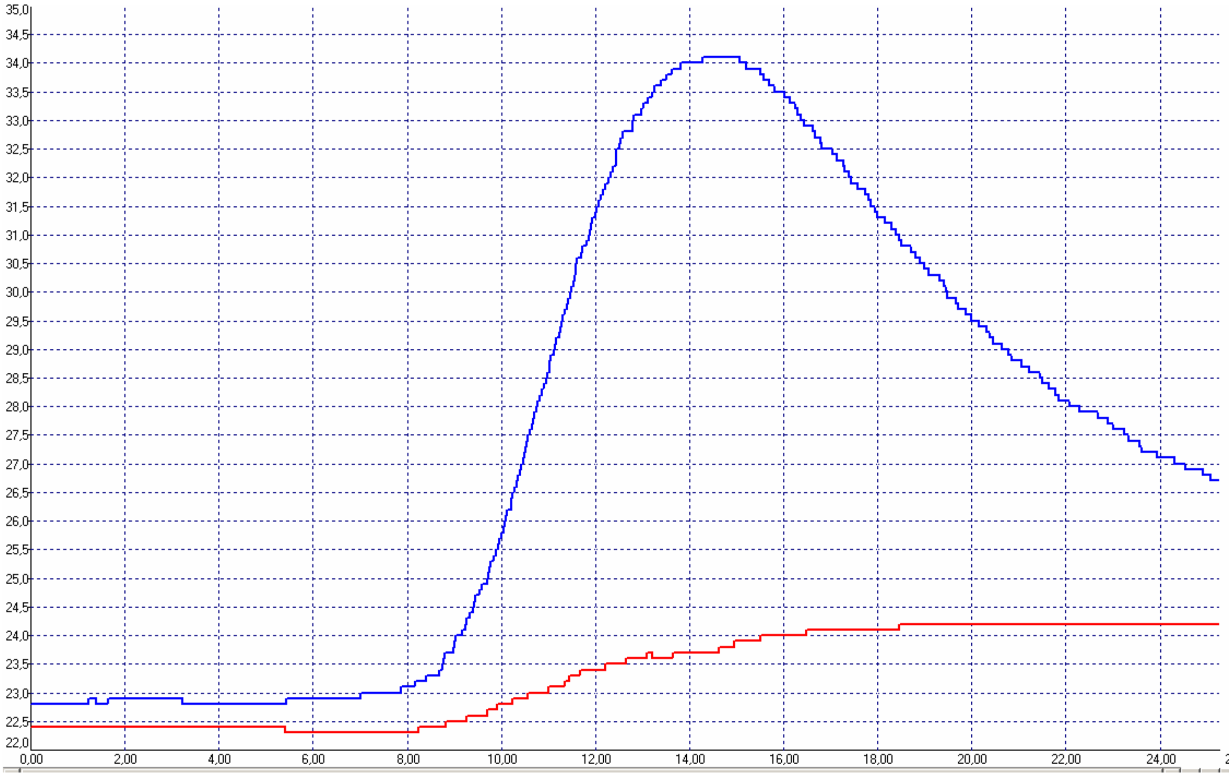
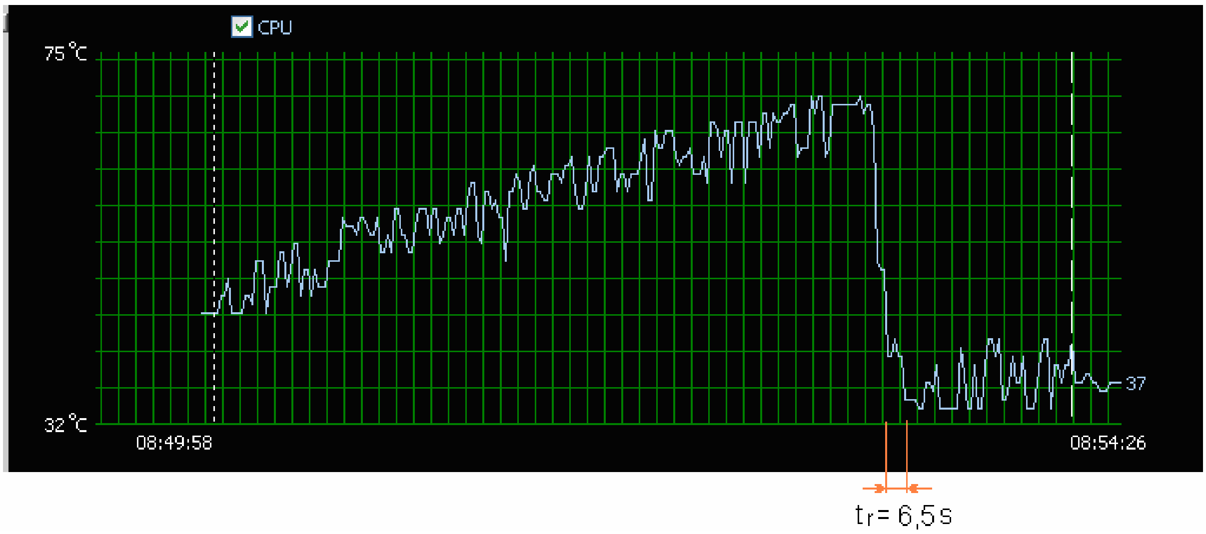


Fig 9. The variation of temperature of the cooling exchanger - Section A and T1 temperature variation

As a partial conclusion can be observed that the probe measured temperature T1 increases with decreasing temperature in the process of cooling the fluid passing over the microprocessor by passage through heat exchanger.

Has represented the variation of temperature of microprocessor for the operation I:



I

Fig 10. The variation of temperature of microprocessor (CPU): A section for the operation I

Following pass through all the possible change in the operating regimes of the cooling microprocessor with a heat exchanger with microchannels was obtained with a series of data and features that have analyzing and synthesized into a series of charts and variation computers that have established that the cooling system with heat exchanger with microchannels is effective and shows a high stability in operation.

In chapter seven**, Personal contributions and final conclusions** are presented final conclusions and the author's personal contributions made by theoretical and experimental research carried out during preparation of doctoral thesis.