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**ELECTRONIC RECORDER WITH PROCESSING
SIGNALS FROM HEAT FLUX
THERMOELECTRIC SENSOR**

This paper presents the results of electronic recorder development with processing signals from thermoelectric sensor intended for contact measurement of human heat flux density and temperature. Its structural features, technical characteristics and functional block-diagram are shown.

Key words: electronic recorder, thermoelectric sensor, heat flux.

Introduction

General characterization of the problem. Thermoelectric sensors are becoming more common in various branches of medicine. A factor of importance in the investigation of human heat fluxes using such sensors is the accuracy and speed of recording signals from thermoelectric sensors.

Analysis of the literature. The need in high accuracy and speed of heat flux measurements leads to complication of electric circuits and enlargement of devices for recording signals from thermoelectric sensors. The existing devices of this type [1-4] have a relatively high measurement error, large dimensions and a low speed and are incapable of measurement time control. The main disadvantage of these devices is the absence of internal memory for storing measurement results and a demand for external power supply. Therefore, it is of current concern to develop a self-contained electronic recorder characterized by improved accuracy of measuring signals from heat flux thermoelectric sensor and high speed of processing and storing the measured data

The purpose of this work is to develop an electronic recorder with processing of signals from thermoelectric sensor that assures simultaneous measurement of human heat flux and temperature and recording their values in time.

Electronic recorder design and technical characteristics

At the Institute of Thermoelectricity NAS and MESYS of Ukraine an electronic recorder with processing signals from heat flux thermoelectric sensor has been developed (Fig. 1).

Device block-diagram (Fig. 2) consists of the following functional assemblies: thermoelectric sensor with a built-in thermocouple for measuring human heat flux and temperature, thermocouple signal amplifier with ambient temperature compensator, analog-to-digital converters for conversion of analog sensor signals into digital ones, digital signal processing unit for storing and graphic reproduction of data on the display.

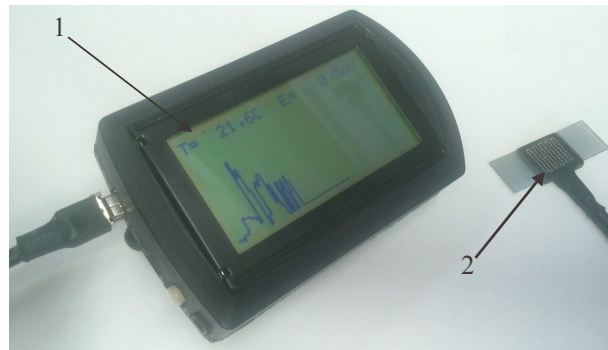


Fig. 1. Electronic recorder with processing signals from heat flux thermoelectric sensor:
1 – electronic recorder; 2 – thermoelectric sensor.

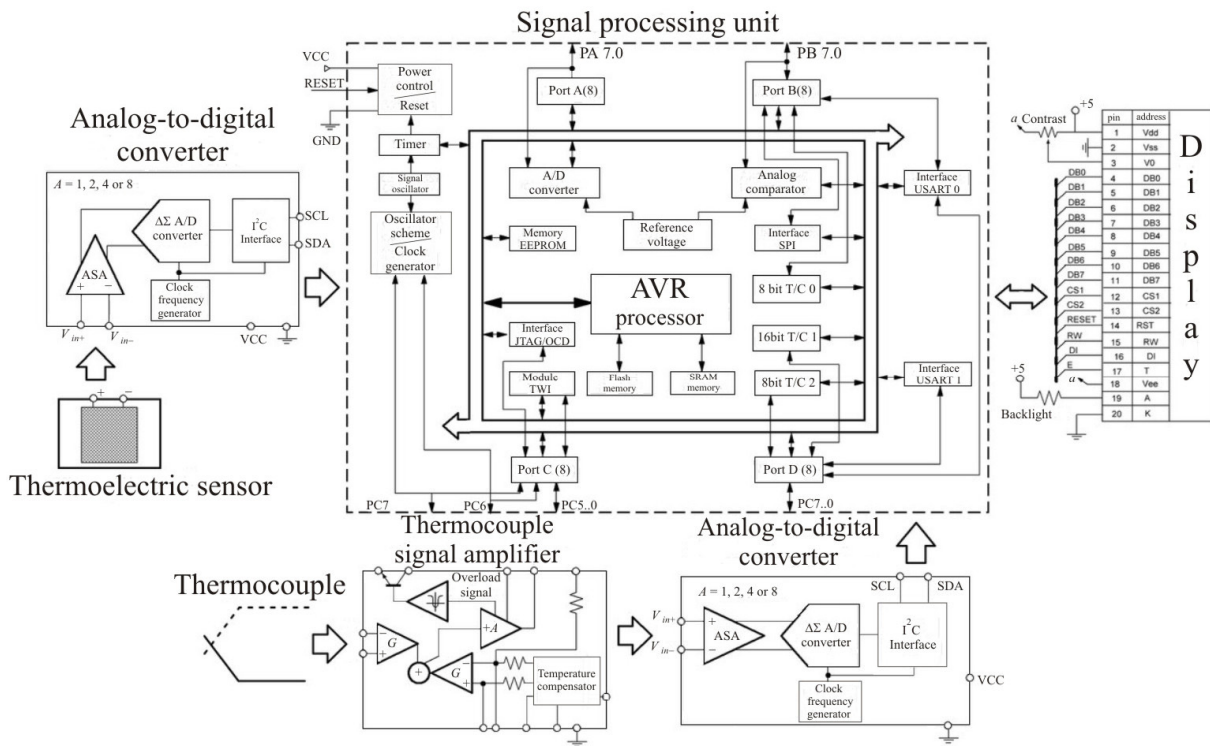


Fig. 2. Device block-diagram.

The main functional assembly of signal processing unit is a microcontroller [5] operating at a frequency up to 20 MHz which assures high processing rate of signals from thermoelectric heat flux sensor and comprises 32 Kb of internal memory. Personal computer is used to program the microcontroller which, in turn, controls the work of other functional assemblies of the block-diagram, information display and read-in

The left sidewall of the device has a socket for connection of heat flux thermoelectric sensor, a switch button and a socket for battery recharging. Thermoelectric sensor is connected to electronic recorder with the aid of a mini USB-connector. This allows replacing thermoelectric sensors in case of their failure and using sensors of varying configuration and geometry, which makes this device more convenient in operation.

Mounted on the front wall of the case is a liquid-crystal monochrome display with a resolution of 128×64 pixels. One pixel of display screen is matched by 5 mV of thermoelectric sensor

electromotive force. The display shows plotted values of the heat flux of respective human body area in millivolts (mV) and temperature values in centigrade (°C). Thus, previous measurement data can be analyzed directly from the plot shown on the display.

Device power supply is from lithium-ion battery of capacity 1000 mA/h assuring 10 hours of uninterrupted device work. Device supply voltage is 3.3 V, current consumption is 100 mA, the accuracy of measuring human body temperature is ± 0.1 °C, the accuracy of measuring the thermoelectric sensor electromotive force is 2 – 3 mV. The overall dimensions of the electronic recorder are $90 \times 58 \times 24$ mm and the device weight is 0.15 kg.

Conclusions

1. An electronic recorder of signals has been developed that enables simultaneous determination of temperature and heat fluxes with recording their values in time over the course of 10 hours. The device assures visualization of signals in the form of time-dependent plots. Information transfer to personal computer for its subsequent processing according to the assigned algorithm is provided.
2. The device allows identifying the peculiarities of heat release on human skin surface for a correlation with human state.

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