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WSPÓŁCZESNE INFORMACYJNE TECHNOLOGIE

Komputerowa inżynieria

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RESEARCH OF LIGHT FLOW PULSATION IN LED MONITORS

One of the important characteristics of artificial lighting is the pulsation of light flux or, as is often said, flicker of light. The pulsation is practically not perceived, since the pulsation frequency exceeds the critical frequency of blinking, but has not favorable affect on the person, causing increased fatigue. The negative effect of the pulsation increases with its increase, there is tension in the eyes, fatigue, difficulty concentrating on complex work, headache.

The research of the pulsation of the light flux is dedicated to the work of G. Muduli, S. Nath, B. Pradhan, V. I. Korneichuk, K. G. Samofalov, V. P. Tarasenko and others. However, the creation of an effective LED research model based on easily accessible specialized components, in the reality of the widespread usage of LED light sources, is devoted insufficient attention.

Thus, the development of a physical research model for studying the characteristics of artificial lighting, namely the pulsation of light flux, is an actual scientific and practical task.

The purpose of the study is to verify the pulsation of the light flux of modern monitors constructed using an LED backlight matrix based on an oscilloscope and a photodiode, by creating a research model and obtaining from it coefficient of pulsation illumination.

To achieve this goal, the following tasks must be solved:

analyze the existing methods of measuring the light source's pulsation;

development of figurative and sign models of the device to research the characteristics of artificial lighting;

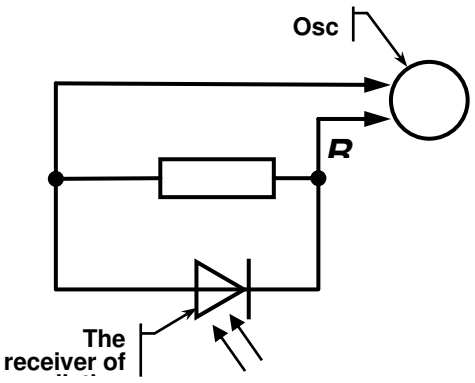
create a research model that will determine the coefficient of light pulsation in the workplace and carry out practical measurement.

Solution to the task. According to sanitary norms, when working with a computer monitor, the level of pulsations, up to 300 Hz, should not exceed 5 %. The pulsation frequency of the light flux of 100 Hz exceeds the critical frequency of blinking, so the light fluctuations are not visually perceived, but their negative impact on the human body has been established in numerous studies. Numerous experiments have shown that at a frequency of light oscillations of 100 Hz, the negative impact on the human body is small only at a depth of ripple of no more than 5-6 %. When feeding light sources with a current of 300 Hz and above, the pulsation depth does not matter, since the brain does not react at this frequency. Therefore, research on pulsation of artificial lighting is a very important task.

There are several methods for measuring the light source's pulsation. The first ones is based on special equipment, where instruments measuring radiation transducers are used to measure the pulsation of illumination with a limit of the permissible error of measuring instruments not more than ± 10 %, taking into account the error of the spectral correction, which is defined as the deviation from the relative spectral sensitivity of the measuring transducer of radiation from the relative spectral light the effectiveness of monochromatic radiation for daily vision [1].

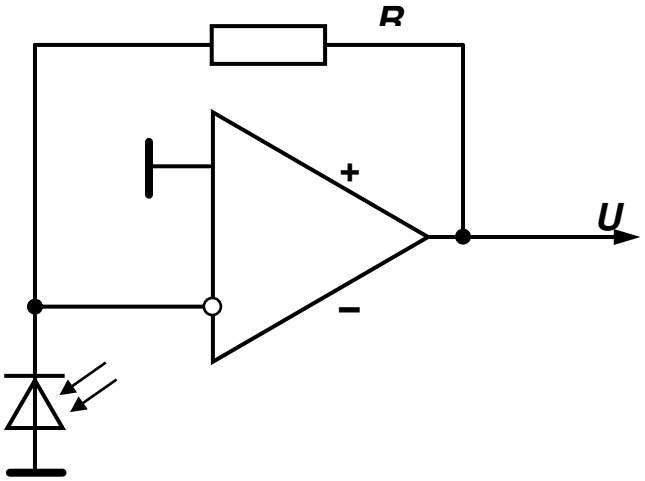
Others use improvised means for less accurate flicker detection and designed for household use. For example: using a photodiode, a resistor, connecting to a computer’s linear input or connecting it to the microphone input of the computer; estimating the pulsation factor using a camera, listening to pulsations through the headphones and measuring the pulsation coefficient using a multimeter.

The developed device is based on special equipment and allows to see the pulsations of the signal frequency up to several kHz. You can extend the frequency range of measurements by loading the photodiode of resistance (Figure 1) by 10...100 kOhm by reducing the constant time $\tau = RC$, but with the same amount of sensitivity falling [2].



Picture 1 – Figurative and sign model for measuring the lightning pulsations using an oscilloscope

In the developed device, an operating amplifier (OP) is additionally used according to the typical inclusion scheme shown in Figure 2.



Picture 2 – Figurative and sign model of connection of the OP to the measurement scheme

The peculiarity of this scheme is that, with a grounded non-inverting input OP, a negative feedback tends to set such a voltage at the output of the amplifier to align the potential with the inverting input. And since the photodiode is turned on directly between the OP inputs, a mode of operation is created which is close to the short circuit for the photodiode, providing a small τ, and, as a result, a high-speed circuitry.

Conclusions

In the work is solved the scientific and practical task of verifying the pulsation of the light flux of modern monitors constructed with the use of the LED backlight of the matrix, namely the obtaining of the values of the pulsation coefficient of illumination with the help of the created research model.

The analysis of existing modern methods of measuring the light source's pulsation has been carried out, which allowed to identify the main components of the physical research model. Based on these components, a physical research model is developed that is universal for verifying the pulsation of light flux, which allows to speed up the procedure for determining the most appropriate monitor to the hygienic requirements of Ukraine.

As a result of the study, with the help of the developed device, more than a dozen monitors were analyzed in the workplaces of employees for compliance with norms. Unfortunately, only with 100 % brightness of the monitors, the pulsation of the backlight was within the normal range. When the brightness is lowered below 70 %, all monitors have exceeded the permissible limits, exceeding the established norm for the pulsation of light at the workplace with a computer equal to 5 % [3].

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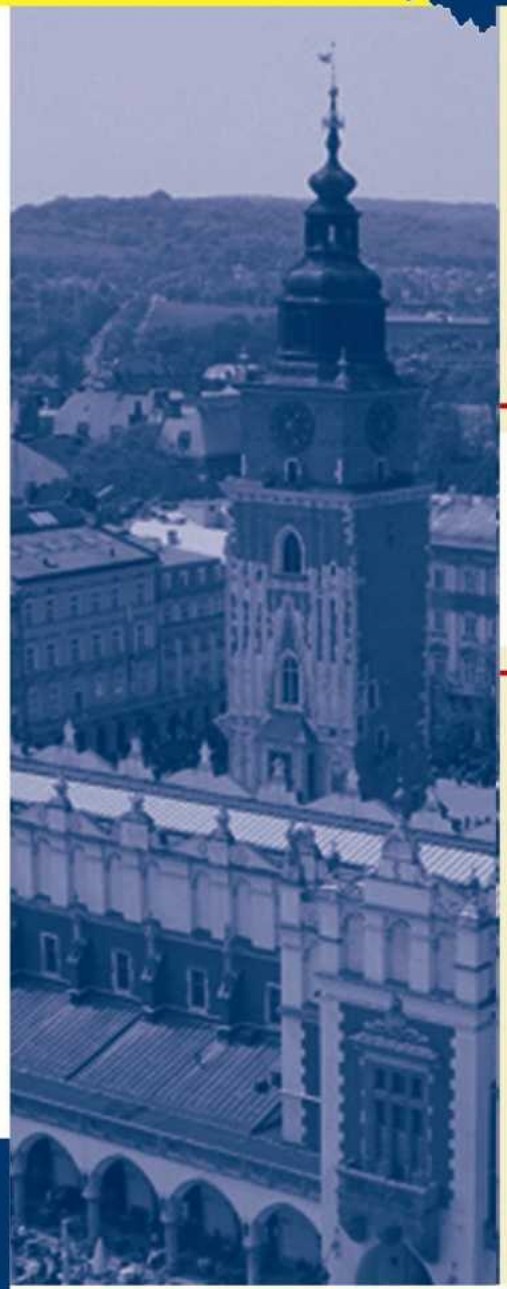

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Research of light flow pulsation in led monitors

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