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TECHNICAL ASPECTS OF THE IMPLEMENTATION OF AN ENERGY-SAVING SYSTEM BASED ON A DIMMER

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ANNOTATION

This article discusses the most important performance characteristics of dimmer-based LED lighting.

KEYWORDS: ***dimmer, energy saving, step switching mode.***

INTRODUCTION

In the context of the predicted natural reduction in the reserves of traditional hydrocarbon raw materials and the corresponding increase in prices for traditional energy resources, ensuring efficient energy consumption is an important task of increasing the competitiveness of the economy for all countries. Taking into account that the volume of energy consumed in Uzbekistan by 2030, taking into account population growth, GDP, acceleration of urbanization processes, other things being equal, may increase from 60 million toes. Up to 150 million toes, comprehensive measures to improve energy efficiency are required [1-3].

MATERIALS AND METHODS

The intelligence of the basic level is manifested in the possibility of changing the luminous flux of the luminaires depending on external conditions.

These conditions can be:

- a schedule that determines the decrease in luminous flux and electricity consumption in the evening and at night;
- signals from light or presence sensors, allowing to reduce luminous flux and energy consumption in case of sufficient natural light or the absence of people;
- Commands sent manually when a person wants to reduce the illumination level on their own.

The main benefit of adding such intelligence to a lighting system is obviously energy savings. Moreover, the cost of such a system turns out to be quite low, since its functionality is extremely simple. In the case of group control, the luminous flux can be changed both for a group of luminaires and for all luminaires in the network at once [4-5]. This is not always acceptable.

In the field of street lighting, the simplest and most popular system is to reduce the luminous flux of luminaires by reducing the supply voltage in the line. As an example, we can name the control system "BRIZ" from Svetoservice Telemechanika, "Kulon" from Sandrax, voltage regulators from Reverberi. Initially, such systems were designed to work with gas-discharge light sources and electromagnetic ballasts, but with the advent of electromagnetic power supplies for semiconductor light sources, it became possible to use LED lamps as part of such control systems. For example: GALAD Victory LED, GALAD Omega LED or GALAD Wave LED [6-7].

In group control systems for street lighting, you can also find light sensors that automatically turn on and off each lamp or line of lamps at dusk (Fig. 2).

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Fig. 1. Illumination Sensor on a Gas-Discharge Luminaire

For address management in street lighting, various solutions are now used: these are all kinds of systems based on wireless digital radio communication protocols, such as ZigBee, which allow you to create a complex multi-cell network and automatically rebuild the message transmission routes over the network. Network in case of any malfunctions; and high frequency PLC power line communication; and a SEAK-type supply voltage amplitude modulation system. There are many options, they all have their pros and cons, and it is difficult to call a particular option the most popular.

Replacing outdated light sources with modern ones is a sure step towards economical lighting costs and obtaining quality lighting. Street lamps based on HPS sodium lamps (arc, sodium, tubular), which until recently had no alternative, are giving way to a new type of street lamps - LED. Indeed, when replacing street lighting devices with HPS lamps with LEDs, energy savings reach 50%, not to mention saving on work on replacing failed lamps - LED lamps last 5 times longer than sodium lamps.

But LED lights provide another great savings opportunity - dimming. Dimming is a decrease in the brightness of the lamp at a time when we do not need bright lighting. Indeed, why force the lamp to run at full power late at night when no one is outside? Indeed, by reducing the brightness, we not only reduce energy consumption, but also increase the lamp life by 1.5 - 2 times! And this is also a significant saving, both in the cost of the lamp itself and in the work on its replacement.

It turns out that you need a device that will control the operation of the lamps - decrease and increase the brightness if necessary. For this, smart street lighting control systems were invented based on adjustable street lights and street light controllers. They allow you to control the light by turning the luminaire on and off, switch it to night mode with reduced power consumption, transmit data on the status of each luminaire, etc. using PLC technology or wireless data transmission via radio. Channel, we collect statistics on the operation of the lamp and report it in case of emergency situations.

But here, as in any other technical system, there are modules that perform the basic, so-called "useful work", and there are modules that endow the system with certain additional functions, which usually require significant monetary allowances. But is it always necessary? For example, it makes no sense to "overpay" two or three prices for additional service functions for an investor performing work on the modernization of urban street lighting within the framework of an energy service contract - the attractiveness of the project is sharply reduced. But what about small businesses, institutions or urban settlements, in which 10-100 lamps illuminate the adjacent territory or streets? They will never buy a dispatcher outdoor lighting system.

For such cases, there is a solution based on an autonomous street lighting controller. This device does all the work that generates income - switches the luminaires at night to low power consumption mode according to the scheme 100-50-100% or 100-75-50-75-100% of the nominal power. Any automation, including those already installed in lighting control cabinets, can turn on and off 380/220 V street lighting lines - from a conventional photo relay to modern centralized control systems based on GPRS modems [7-9].

DISCUSSION RESULTS

The result is a street lighting control system with so-called "distributed intelligence", which is an order of magnitude more reliable than centralized. A similar approach is used now, for example, in high-class fire alarm systems, where it is the sensor, and not the fire alarm post, that fixes the fact of fire on the spot.

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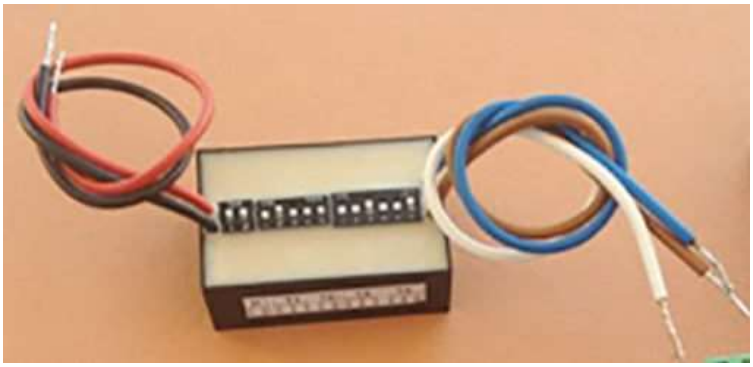

Fig. 2. Dimmer structure.

This is an electronic device (hereinafter referred to as a dimmer), enclosed in a compact sealed composite case with connectors for wires. Dimmer 45 mm x 30 mm x 15 mm. There is a DIP switch on the front panel for adjustment. If you want to achieve an IP67 degree of protection, after setting the dimmer, a transparent protective neutral silicone sealant must be applied over the DIP switches.

Fig. 3. Three-Stage Switching Mode.

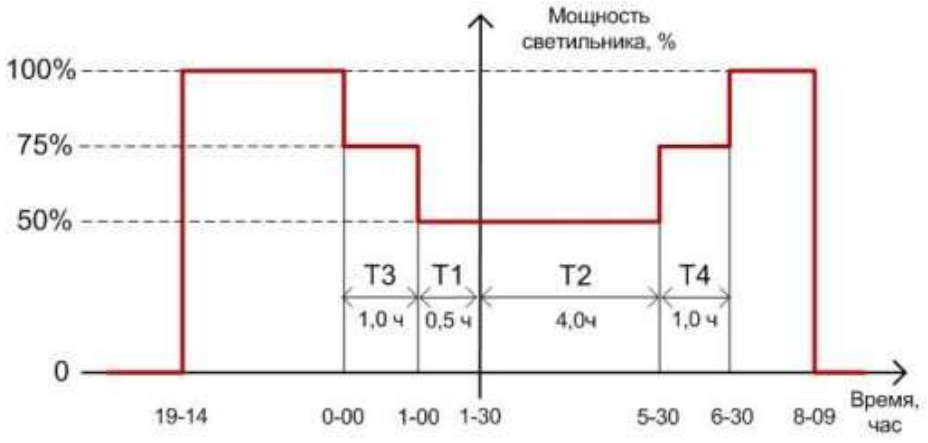

Fig. 4. Five-Step Switching Mode.

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CONCLUSION

At the heart of the dimmer is a powerful enough “self-learning” microcontroller, which daily fixes the time of switching on and off the lighting and calculates the so-called “estimated midnight”, from which the start and end times of dimming are then set (see Figures 1 and 2). To program the dimmer, you need to find out the time of switching on and off the lighting and determine the middle of this interval. This will be the "estimated midnight". Moreover, this figure is correct for any month of the year +/- 10 minutes! Now that we know the time of the estimated midnight, we just need to set in the dimmers with the help of special DIP-switches the power down time before and after this “estimated midnight”. This is called a dimming plan (schedule). You do not need complex and not always reliable methods and systems for transmitting control commands over the power network or radio channel from the dispatcher to the control cabinet and from the control cabinet to the luminaires! Knowing the real operating time of the lighting system for the last three days, the dimmer itself will ensure the timely switching of the luminaire to the night power reduction mode and vice versa. The dimmer functions completely autonomously! At the same time, the dimmer ignores long and short switching intervals, which may occur during the repair of lighting lines or a malfunction of the control cabinet. In the simplest case, you can set a dimming plan in three steps: in the evening hours, the brightness is 100%, at night - 50%, in the morning 100%. Or set a more flexible five-step schedule: 100% - 75% - 50% - 75% - 100%. Knowing the real operating time of the lighting system for the last three days, the dimmer itself will ensure the timely switching of the luminaire to the night power reduction mode and vice versa. The dimmer functions completely autonomously! At the same time, the dimmer ignores long and short switching intervals, which may occur during the repair of lighting lines or a malfunction of the control cabinet. In the simplest case, you can set a dimming plan in three steps: in the evening hours, the brightness is 100%, at night - 50%, in the morning 100%. Or set a more flexible five-step schedule: 100% - 75% - 50% - 75% - 100%. Knowing the real operating time of the lighting system for the last three days, the dimmer itself will ensure the timely switching of the luminaire to the night power reduction mode and vice versa. The dimmer functions completely autonomously! At the same time, the dimmer ignores long and short switching intervals, which may occur during the repair of lighting lines or a malfunction of the control cabinet. In the simplest case, you can set a dimming plan in three steps: in the evening hours the brightness is 100%, at night - 50%, in the morning 100%. Or set a more flexible five-step schedule: 100% - 75% - 50% - 75% - 100%. At the same time, the dimmer ignores long and short switching intervals, which may occur during the repair of lighting lines or a malfunction of the control cabinet. In the simplest case, you can set a dimming plan in three steps: in the evening hours, the brightness is 100%, at night - 50%, in the morning 100%. Or set a more flexible five-step schedule: 100% - 75% - 50% - 75% - 100%. At the same time, the dimmer ignores long and short switching intervals, which may occur during the repair of lighting lines or a malfunction of the control cabinet. In the simplest case, you can set a dimming plan in three steps: in the evening hours, the brightness is 100%, at night - 50%, in the morning 100%. Or set a more flexible five-step schedule: 100% - 75% - 50% - 75% - 100%.

In five-step mode, the dimmer can save up to 40% energy.

REFERENCES

1. *Resolution of the President of the Republic of Uzbekistan No. 4422 "On accelerated measures to improve the energy efficiency of economic and social sectors, the introduction of energy-saving technologies and the development of renewable energy sources." 08/22/2019*
2. *Harutyunyan, A.A. Fundamentals of energy saving / A.A. Harutyunyan. - M .: Energoservice, 2018 .-- 949 p.*
3. *Samarin, O.D. Thermophysics. Energy saving. Energy efficiency / O.D. Samarin. - M .: Publishing house of the Association of building universities, 2020 .-- 296 p.*
4. *Sviderskaya, O. V. Fundamentals of energy saving / O. V. Sviderskaya. - M .: TetraSystems, 2016 .- 176 p.*
5. *Handbook of radio electronics (set of 3 books). - Moscow: SINTEG, 2016 .-- 186 p.*
6. *www.gigavat.com*
7. *www.biy.ru*
8. *intelar.ru/ru/upr-ulich-osv/*
9. *parkinglight.io/ru/avtonomnoe-dimmirovanie*