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Use Of Electronic Keys To Increase Energy Savings Of Led Lights

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ABSTRACT

In everyday life, all kinds of lamps illuminate our work and life, giving us night light. Today, LED lamps and energy-saving lamps are the most common on the market. However, with the development of social sciences and technology, human demand for quality of life is increasing and is gradually becoming more rational and energy efficient. Compared to energy-saving lamps, LED lamps have become a trend.

KEYWORDS

Tiristor, mikroprosessor, energy, resources savings, capacitance energy, stirrer – up, lamp, bipolar transistor, emitter current.

INTRODUCTION

The modification of the LED lights we offer will allow qualified LED bulbs to increase their lifespan by 10,000-20,000 hours. As a result, the cost-effectiveness of using LED bulbs increases. [1]

MATERIALS AND METHODS

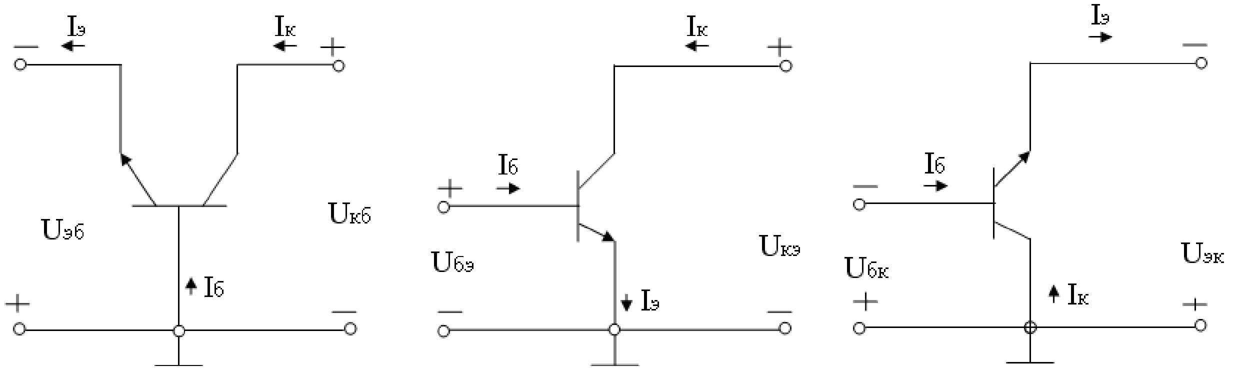
The LED lights we use today have a simpler structure. The principle of operation is also very simple.

In these lamps, the LEDs are connected in the form of a matrix and are powered by an alternating current source. At any given time, all the LEDs are in the same state.

Therefore, by dividing the matrix-connected LEDs into several groups, we can achieve a reduction in energy consumption for LED lamps and extend the life of the LED lamp by applying a circuit that turns each disconnected group of high-frequency LEDs in turn. [1]

To do this, we need to calculate the transistor electronic switch in accordance with the parameters of our LED lamp and create an electronic circuit diagram. We are satisfied with the fact that the electronic switch has a value of a few kilograms, which is enough for the frequency of our device. So first we need to look at what wiring diagram transistors can be used for as an electronic switch. In this case, we must first determine the desired connection scheme of the transistor.

Wiring diagrams of bipolar transistors. When a transistor is connected to a circuit, one of the outputs is connected in common to the input and output circuits, so the following connection circuits are available: common base (UB) (Figure 1 a); common emitter ($U_э$) (Figure 1 b); common collector (U_k) (Fig. 1 v). At this time, the total output potential is assumed to be zero. The direction of the power supply poles and the direction of the transistor currents correspond to the active mode of the transistor. The U_6 connection scheme has a number of shortcomings and is rarely used. [2]



a) b) v)

Figure 1. Wiring diagrams of bipolar transistors.

Operation of bipolar transistor in active mode. In the UV connection diagram, we consider the operation of a bipolar transistor with a diffusion alloy of n-p-n structure operating in active mode at constant current (Fig. 1 a). [2]

The operation of a bipolar transistor is based on three main phenomena:

- Injection of charge carriers from emitter to base;

- Transfer of injected charge carriers to the collector;
- Injected charge carriers and collectors into the base-extraction of incoming non-core charge carriers from the base to the collector.

When the emitter switch moves in the right direction (supplied by the $U_{эб}$ voltage source), its potential barrier height decreases and electrons are injected from the emitter to the base.

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Due to the injection of electrons into the base, as well as the injection of holes from the base into the emitter, an emitter current $I_э$ is formed.

Thus, the emitter current

$$I_Э = I_{эn} + I_{эp} \quad (1.1)$$

where $I_{эn}$ and $I_{эp}$ are the injection currents of electrons and cavities, respectively.

The Iep component of the emitter current does not flow through the collector and is considered harmful (causing additional heating of the transistor). In order to reduce Ier, the acceptor input concentration in the base is reduced by two degrees relative to the donor input concentration in the emitter. [2]

The I_{ep} portion of the emitter current is determined by the injection coefficient.

$$\gamma = \frac{I_{эn}}{I_Э} \quad (1.2)$$

This magnitude characterizes the efficiency of the emitter operation (γ =0,990-0,995).

The injected electrons diffuse to the base due to the decrease in electron density along the base length towards the collector junction, and when they reach the collector junction, they are extracted to the collector (the junction is pulled by the electric field) and I_{Kn} collector current is generated.

The decrease in density is called the concentration gradient. The larger the gradient, the larger the current. It should also be taken into account that some of the electrons injected from the base at this time are extracted to the base by cavities. The recombination process results in a lack of cavities required to restore the base's electrical neutral condition. The required holes run along the base circuit to form the transistor base current I_{brek}. I_{brek} current is not considered necessary and therefore efforts will be made to reduce it. This is done by reducing the base width $W \le L_n$ (diffusion length of electrons). The loss of emitter electron current for base recombination is characterized by the electron transfer coefficient:

$$\alpha_П = \frac{I_{Kn}}{I_{Эn}} \quad (1.3).$$

In real transistors $\alpha_П$ =0,980-0,995.

In the active mode, the collector passage of the transistor is connected in the reverse direction (due to the U_{kb} voltage source) and in the collector circuit, the specific current of the collector I_{ko} flows, consisting of two drift currents consisting of non-main charge carriers. [2]

Thus, the collector current consists of two components

$$I_K = I_{Kn} + I_{K0}$$

If we take into account the relationship of I_{Kn} with the total current of the emitter, then

$$I_{Kn} = \alpha I_Э + I_{K0} \quad (1.4)$$

here $\alpha = \gamma \alpha_П$ - emitter current transfer coefficient. This size reflects the amplifier amplification properties of the $U_б$ connection circuit.

According to Kirchhoff's first law, the base current is related to the other currents in the transistor in the following ratio

$$I_Э = I_Б + I_K . \qquad (1.5)$$

ubstituting this expression into (3.4), we can obtain the expression of the base current through the total current of the emitter:

$$I_Б = (1-\alpha) I_Э + I_{K0} . \quad (1.6)$$

Given the coefficient α <1, it can be concluded that the UB connection scheme does not provide current gain ($I_K \approx I_Э$).

Good current gain results can be obtained with a transistor connected in a common emitter circuit (Figure 1 b). In this circuit, the emitter is the common electrode, the base current is the input current, and the collector current is the output current. [2]

From the expressions (3.4) and (3.5) the collector current of the transistor in the UE circuit has the following form:

$$I_K = \alpha (I_K + I_Б) + I_{K0} .$$

From this

$$I_K = \frac{\alpha}{1-\alpha} I_Б + \frac{1}{1-\alpha} I_{K0} . \quad (1.7)$$

If a notation is entered $\beta = \frac{\alpha}{1-\alpha}$, expression (1.7) can be written as follows:

$$I_K = \beta I_Б + (\beta + 1) I_{K0}. \qquad (1.8)$$

The coefficient β is called the base current transfer coefficient. Can range β in value from tens to hundreds, and in some types of transistors from several thousand. This means that a transistor connected in a U_3 circuit has good current amplification properties. [2]

Therefore, as an electronic switch circuit, we choose an electronic switch with a transistor connected in the U_3 circuit. This is because a transistor connected in a U_3 circuit has good current amplification properties.

This method can create a number of other savings and conveniences. If our lights are battery-powered, the savings will be even greater. Even the battery life can be extended for a while.

For a transistor switch, you do not need to calculate the exact value of the gain. If the gain is too high, the transistor goes into current limiting mode and the output current will be determined by the load resistance. Therefore, it is sufficient to determine only the minimum current gain.

Let's calculate this coefficient. Suppose that energy-saving lamps require a current of 170 mA, and a digital microcontroller can produce a unit current of about 4 mA (this current is determined from the reference book or datasheet for the selected microcircuit). Then the minimum gain h42.5э can be determined by the formula:

$$h21э = I_к / I_б$$

$I_к$ - collector current, $I_б$ - base current.

In our case, the collector current is equal to the current flowing through the lamp, and the base current is the maximum allowable output current of the digital microcircuit ($I_{out}1$). Divide 170 mA by 4 mA. We get the minimum current gain equal to 42.5. That is, in this case, almost any low-power transistor is suitable, for example, KT3107 or an imported S8050 transistor.

Now you should pay attention to the fact that the transistor is controlled by current, and the digital microcircuit is a voltage generator. In the simplest case, a resistor can be used to convert voltage to current. An equivalent circuit for connecting the base circuit of the transistor to a digital microcontroller is shown in Figure 1.

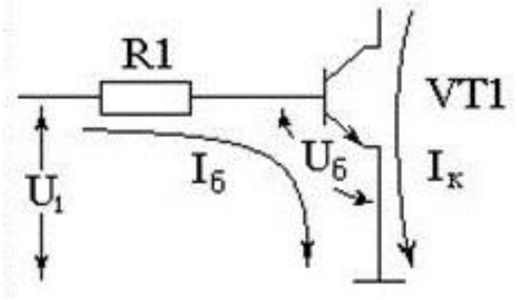

Figure 1 - Equivalent circuit for connecting a transistor switch to a digital microcontroller

In the above diagram, the base current of the transistor is set by the resistor R_1. Let's calculate its resistance. To do this, it is necessary to determine the voltage drop across this resistor. The minimum high-level voltage at the microcontroller output at the maximum allowable unit current is 5 V. The voltage drop at the base junction of the transistor can be considered constant and for silicon transistors equal to 0.7 V. Then the voltage drop across the resistance R_1 can be determined by the formula:

$$UR_1=U_1-U_6=5\text{ V}-0,7\text{ V}=4,3\text{ V}.$$

Since only a transistor switch is connected to the digital output, we will set the maximum possible current of the digital microcircuit 4 mA. Then, according to Ohm's law, the resistance of the resistor R_1 can be determined as the ratio of the voltage drop across this resistor to the current flowing through it:

$$R_1 = 4,3\text{ V}/4\text{ mA} = 1075\ \Omega.$$

When choosing a resistor from 10% of the scale, you can take a 1kΩ resistor (more than calculated so as not to exceed the permissible current of the digital microcircuit). When the transistor switch is operating at room temperature, the calculation ends here. If the transistor switch is supposed to work at elevated temperatures, then the transistor can spontaneously open with a reverse collector current. The equivalent circuit of the circuit for the flow of this current is shown in Figure 2.

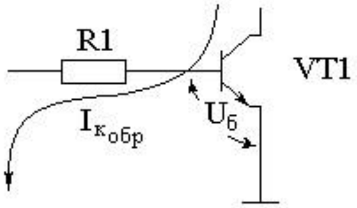

Figure 2 - Equivalent circuit of the reverse collector current flow circuit.

In the circuit shown in Figure 9.7, it can be seen that on the resistor R1 the reverse collector current of the transistor VT1 can create a voltage drop of 0.7 V and, thereby, open the transistor. In order to reduce the voltage drop, you can connect another resistor in parallel with this resistor (as shown in Figure 3) and, thereby, reduce the opening voltage at the base of the transistor.

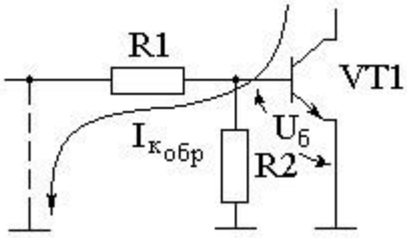

Figure 3 - Equivalent circuit for shunting the reverse collector current flow circuit $I_{\text{ко}}$ of the transistor switch with a resistor.

In the circuit shown in Figure 3, you can set the current flowing through the resistor R2 in the single-level digital microcircuit output mode. Let this current be three times less than the base current of the transistor. Then the current through the resistor R2 will be equal to:

$$IR_2 = 4\ \text{mA}/3 = 1{,}3\ \text{mA}.$$

Determine the resistance of the resistor R_2. To do this, we will use Ohm's law. Considering that the voltage drop at the base junction of the transistor is constant and equal to 0.7 V.

$$R_2 = U_{\text{б}}/IR_2 = 0{,}7\ \text{V}/1{,}3\ \text{mA} = 510\ \Omega.$$

In the output mode of the digital microcircuit of a logical zero, the resistances R1 and R2 are connected in parallel, and in the calculated case, the voltage drop is halved. Please note that the circuit at the input of the transistor is very similar to the voltage divider, but it is not. If it were a voltage divider, then the voltage at the base of the transistor would be halved, but in fact, the voltage decreases much more!

REFERENCES

1. Improving Energy Efficiency of Energy Saving LED Lighting.
2. I.M. Saydumarov, S.M. Shukurova. Electronics and circuitry. Textbook - Tashkent: TSTU, 2014, 110 p.
3. The General Structure of The Microprocessor / Oybek Bakhtiyorjon ogli Parpiev // The American Journal of Engineering and Technology, November 20, 2020, Volume: 02, Isusue: 11-04. Pages: 25-30.Doi:https://doi.org/10.37547/tajet/Volume02Issue11.
4. The Pecularities Of Automatic Headlights / D.D. Alijanov, U.A. Axmadaliyev // The American Journal of Engineering and Technology 2020. PP 13-16.
5. Optoelectronic Method for Determining the Physicochemical Composition of Liquids / D.D. Alijanov, N.R. Rakhimov // © Автоматика и программная инженерия.

2020, №2(32) http://www.jurnal.nips.ru С. 51–53.

6. POWER SUPPLY GROUNDING STUDY / Alimjon Ahmedov, Oybek Parpiyev // UNIVERSUM: ТЕХНИЧЕСКИЕ НАУКИ. 2021, № 4(85). Часть 4, http://7universum.com/ru/tech/archive/category/485. DOI: 10.32743/UniTech.2021.85.4-4. PP 82-84.