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Discourses on the Teaching of the Topic of the Bipolar Transistors

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Abstract: In the following article discourses on the teaching of the topic of the bipolar transistors are drawn based on the recent scientific data with retrospective approach

Keywords: semiconductor, bipolar transistor, power circuit, diodes, triodes, vibrations, oscillation

Introduction. A transistor is an active semiconductor device designed to amplify a signal and generate vibrations. It replaced the vacuum tubes - triodes. Transistors usually have three legs – collector, emitter and base. The base is a control electrode, by applying current to it, we control the collector current. Thus, with the help of a small base current, we regulate large currents in the power circuit, and this is how the signal is amplified. Bipolar transistors come in direct (PNP) and reverse conduction (NPN). Their structure is shown below. Tellingly, the base occupies a smaller volume of a semiconductor crystal. [1, 34]

Methods and The transistor appeared in 1948 (1947), thanks to the work of three engineers and under William Shockley at Bell Labs, and Walter Brattain, John Bardeen. The three physicists who invented the transistor; William Shockley, John Bardeen, were all awarded with the Nobel Prize. At that time, they had not yet assumed such a rapid development and popularization. In the Soviet Union in 1949, a prototype transistor was presented to the scientific world by Krasilov's laboratory, it was a C1-C4 (Germanium) triode. The term transistor appeared later, in the 50s or 60s.

Transistors were originally manufactured using Germanium. This was the standard for the first decade of transistor production. The Silicon-based transistors that are used to seeing today were adopted because Germanium breaks down at 82,2 degrees Celsius. [2, 332]

However, they found widespread use in the late 60s, early 70s, when portable radios came into fashion. By the way, they were called "transistor" for a long time. This name stuck due to the fact that they replaced electronic lamps with semiconductor elements, which caused a revolution in radio engineering. Since the topic of transistors is very, very extensive, there will be two articles devoted to them: separately on bipolar and separately on field-effect transistors. The transistor, like the diode, is based on the phenomenon of the p-n junction. Those who wish can refresh their memory of the physics of the processes taking place in it here or here. The necessary explanations are given, let's get to the point. Definition and history. A transistor is an electronic semiconductor device in which the current in the circuit of two electrodes is controlled by a third electrode. The first field-effect transistors were invented (1928), and bipolar ones appeared in 1947 at Bell Labs. And it was, without exaggeration, a revolution in electronics.[3, 56]

Very quickly transistors replaced vacuum tubes in various electronic devices. In this regard, the reliability of such devices has increased and their sizes have significantly decreased. And to this day, no matter how "fancy" the chip is, it still contains a lot of transistors (as well as diodes, capacitors, resistors, etc.). Only very small ones.

The main function of a bipolar transistor (BT) is to increase the power of the input electrical signal. These semiconductor radio components appeared as an alternative to electro-vacuum triodes, and over

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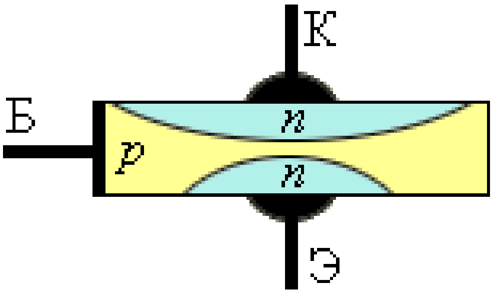
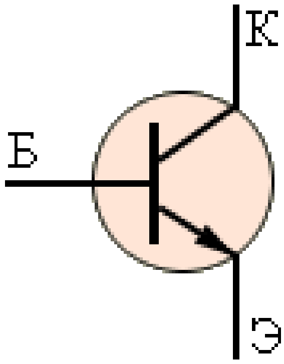
time they were practically ousted from the industry. In fairness, we note that lamps are still used, but in a very, very narrow segment of special-purpose equipment. In mass radio engineering, bipolar transistors and their closest "relatives" field–effect transistors are mainly used.

The key advantage of these elements is their miniaturization. An electro-vacuum amplifier with similar characteristics turns out to be several times larger than a bipolar transistor. As a result, the use of BT in radio electronics leads to a significant reduction in the overall dimensions of the final radio products.

This transistor is called bipolar because both types of charge carriers – both electrons and holes - participate in the physical processes occurring during its operation. This affects the control principle of the output signal. In bipolar transistors, the output parameters are controlled by current, and not by an electric field, as in field (unipolar).





A bipolar transistor consists of three zones: emitter, base and collector, each of which is supplied with voltage. Depending on the type of conductivity of these regions, n-p-n и p-n-p transistors are distinguished. Usually the collector area is wider than the emitter. The base is made of a weakly alloyed semiconductor (which is why it has a large resistance) and is made very thin. Since the emitter-base contact area is significantly smaller than the base-collector contact area, it is impossible to swap the emitter and collector by changing the connection polarity. Thus, the transistor belongs to non-symmetrical devices. [4, 76]

Since the EB transition is open, the electrons easily "run over" to the base. There they partially recombine with holes, but most of them, due to the small thickness of the base and its weak alloying, manage to reach the base-collector junction. Which, as we remember, is enabled with a reverse offset. And since the electrons in the base are non-basic charge carriers, the electric field of the transition helps them overcome it. Thus, the colletor current is obtained only slightly less than the emitter current. Now watch your hands. If you increase the base current, the EB junction will open stronger, and more electrons will be able to slip between the emitter and the collector. And since the collector current is initially greater than the base current, this change will be very, very noticeable. Thus, the weak signal received at the base will be amplified. Once again: a strong change in collector current is a proportional reflection of a weak change in base current.

The second important parameter is the input resistance of the transistor. According to Ohm's law, it is the ratio of the voltage between the base and the emitter to the control current of the base. The larger it is, the lower the base current and the higher the gain.The third parameter of a bipolar transistor is the voltage gain. It is equal to the ratio of the amplitude or effective values of the output (emitter-collector) and input (base-emitter) alternating voltages. Since the first value is usually very large (units and tens of volts), and the second is very small (tenths of volts), this coefficient can reach tens of thousands of units. It is worth noting that each control signal of the base has its own voltage gain.

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Transistors also have a frequency response that characterizes the ability of a transistor to amplify a signal whose frequency approaches the boundary gain frequency. The fact is that with an increase in the frequency of the input signal, the gain decreases. This is due to the fact that the time of the main physical processes (the time of moving carriers from the emitter to the collector, the charge and discharge of barrier capacitive transitions) becomes commensurate with the period of change of the input signal. I.e. the transistor simply does not have time to react to changes in the input signal and at some point simply stops amplifying it. The frequency at which this happens is called the boundary.

Also , the parameters of a bipolar transistor are:

- collector-emitter reverse current
- turn-on time
- reverse collector current
- maximum allowable current
- modes of operation of a bipolar transistor[5, 222]

The above option represents the normal active mode of operation of the transistor. However, there are several more combinations of open/closed p-n junctions, each of which represents a separate mode of operation of the transistor.

Inverse active mode. The BC transition is open here, and the EB, on the contrary, is closed. The amplifying properties in this mode, of course, are nowhere worse, so transistors in this mode are used very rarely.

Saturation mode. Both transitions are open. Accordingly, the main charge carriers of the collector and emitter "run" to the base, where they actively recombine with its main carriers. Due to the resulting redundancy of charge carriers, the resistance of the base and p-n junctions decreases. Therefore, a circuit containing a transistor in saturation mode can be considered short-circuited, and this radio element itself can be represented as an equipotential point.

Cut-off mode. Both transistor junctions are closed, i.e. the current of the main charge carriers between the emitter and collector stops. Flows of non-primary charge carriers create only small and uncontrolled thermal currents of transitions. Due to the poverty of the base and transitions by charge carriers, their resistance increases greatly. Therefore, it is often believed that a transistor operating in cut-off mode is a circuit break.

Barrier mode. In this mode, the base is directly or through a small resistance is closed to the collector. Also, a resistor is included in the collector or emitter circuit, which sets the current through the transistor. Thus, the equivalent of a diode circuit with a series-connected resistance is obtained. This mode is very useful, since it allows the circuit to work at almost any frequency, in a large temperature range and is undemanding to the parameters of transistors.

What is a semiconductor? Transistors are made of semiconductor materials, for example, Silicon, Germanium was previously popular, but now it is rarely found, due to its high cost and worse parameters, in terms of temperatures and other things.

Semiconductors are materials that occupy a place in conductivity between conductors and dielectrics. Their resistance is a million times greater than conductors, and hundreds of millions of times less than dielectrics. In addition, in order for current to flow through them, it is necessary to apply a voltage exceeding the width of the band gap so that the charge carriers move from the valence band to the conduction band.

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Conductors do not have a forbidden zone as such. Move to the conduction band of the charge carrier (electron) it can be not only under the influence of external voltage, but also from heat – this is called thermal current. The current caused by irradiation by the light flux of a semiconductor is called a photocurrent. Photoresistors, photodiodes and other photosensitive elements work on this principle.

Results. So the difference between germanium and silicon structures is that for germanium, the band gap is about 0.3 eV (electron volts), and silicon has more than 0.6 eV. On the one hand, this causes more losses, but the use of silicon is due to technological and economic factors.

As a result of doping, additional charge carriers are obtained, positive (holes) or negative (electrons), this is called a p- or n-type semiconductor. You may have heard the phrase “pn-transition”. So this is the boundary between semiconductors of different types. As a result of the movement of charges, the formation of ionized particles of each type of impurities to the main semiconductor, a potential barrier is formed, it does not allow current to flow in both directions.

Conclusion: The introduction of additional charge carriers (doping of semiconductors) made it possible to create semiconductor devices: diodes, transistors, thyristors, etc.

References.

1. Stepanenko I.P. Osnovi teorii tranzistorov i tranzistornykh skhem. Moskva: Izdatelstvo «Energiya», 1967) 2nd edition. S. 167
2. Stepanenko I.P. Osnovi teorii tranzistorov i tranzistornykh skhem /– M.: Kniga po Trebovaniyu, 2013. – 672 s.
3. Joseph D. Greenfield / Practical Transistors and Linear Integrated Circuits Paperback – January 1, 1988. P.233
4. Burbayeva N.V. Sbornik zadach po poluprovodnikovoy elektronike. Fizmatlit, 2004. S. 211
5. S.M. Sze, Kwok K. Ng. Physics of Semiconductor Devices. Third edition. 2006. P.433.
6. Ismatovna A. Y. The Method of Using the Moodle Platform for the Organization of Teaching in Education (The Introduction of Distance Learning Technologies in the Educational Process) //International Journal of Innovative Analyses and Emerging Technology. – 2021. – Т. 1. – №. 4. – С. 30-46.
7. Асадова Ю. The use of Moodle platform in the traditional transition of Information Technology Science in medicine to foreign students accepted on the basis of MBBS program at Bukhara State Medical Institute //Общество и инновации. – 2021. – Т. 2. – №. 7/S. – С. 35-43.
8. Ismatovna A. Y. Using the Moodle Platform in Extreme Cases //CENTRAL ASIAN JOURNAL OF MATHEMATICAL THEORY AND COMPUTER SCIENCES. – 2021. – Т. 2. – №. 6. – С. 13-19.
9. Ismatovna A. Y. Using the Moodle Platform for Organizing Training in Education (Introduction of Distance Learning Technologies in the Educational Process) //International Journal of Innovative Analyses and Emerging Technology. – 2021. – Т. 1. – №. 4. – С. 63-67.
10. Ismatovna A. Y. Using the Moodle Platform for Organizing Training in Education //" ONLINE-CONFERENCES" PLATFORM. – 2021. – С. 15-18.
11. Ismatovna A. Y. Passing the Traditional Lesson with the Help of Open Moodle Platforms. – 2021.

ISSN 2792-4025 (online), Published under Volume: 1 Issue: 7 in December-2021

12. Sobirovich T. B. The criterion of human indicators in development and renewals in Uzbekistan //EPRA International Journal of Multidisciplinary Research (IJMR). – 2020. – T. 6. – №. 8. – C. 509-511.
13. Sobirovich T. B., Murodogli I. S. The strategy for the implementation of the modern governance system in Uzbekistan //ACADEMICIA: An International Multidisciplinary Research Journal. – 2020. – T. 10. – №. 5. – C. 741-748.
14. Sobirovich T. B. The national and universal principles of democracy in the Central Asian context //International Journal of Advanced Research and Review. – 2021. – T. 6. – №. 1. – C. 30-34.
15. Sobirovich T. B. National Principles of Democracy in Uzbekistan //Mediterranean Journal of Basic and Applied Sciences (MJBAS). – 2021. – T. 5. – №. 3. – C. 131-135.
16. Sobirovich T. B. New Uzbekistan: Socio-Philosophical Analysis of the Strategy of Human Indicators //Available at SSRN 3949264. – 2021.