

工程技术英语注释读物

HOW SEMICONDUCTOR
DEVICES ARE USED?

半导体器件 的应用

清华大学外语教研组 编
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工程技术英语注释读物按机械、动力、电力、电子、建工等不同专业分册出版。文字大部选自原著，对其中个别地方作了适当修改。专业内容浅近易懂。附有注释、参考译文和词汇表，便于读者自学，以培养独立阅读的能力。

这本“半导体器件的应用”是这套读物电子类的第二册之二。第二章及以后的原文选自 Abraham Marcus, *Electronics for Technicians*, 1969。本校力学系热工4班师生参加翻译和校对。

由于编者水平的限制，以及缺乏编写经验，书中肯定存在不少缺点错误，热烈欢迎广大读者提出宝贵的批评意见，以便进一步修改。

编 者

1979年1月

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1. ON THE CORRECT HANDLING OF RELATION BETWEEN THE ELECTRONIC TUBE AND THE SEMICONDUCTOR DEVICE

The semiconductor technology has made rapid headway in the twenty years and more since it started at the end of the 40's.¹ The semiconductor device has, on more than one occasion, replaced the electronic tube. This is an important evolution in the history of modern electronic technology.

An important question in technical policy is whether or not we can recognize in time² and warmly support the new things arising in technical development. At the beginning of the 50's, during the budding period of the semiconductor device, certain countries (the Soviet Union, for instance) saw only the temporary instability of its performance. They were hesitant and unable to make a move, which hindered them from developing the semiconductor device, the integrated circuit and the electronic computer techniques. So, to date they still lag behind.

Our country began to attach great importance to our semiconductor technology as early as 1956 when we worked out the 12-year programme for developing our science and technology. In the twenty years and more since then, we have quickened the step for the expansion of the integrated circuit

1. 40's: (世纪的) 四十年代。是 forty 的复数 forties. 2. in time: 及时地.

as well as the semiconductor device, thus providing a sound basis for us to surpass the world's advanced levels in our electronic technology.

However, following the development of the semiconductor technology, there arise such opinions in foreign electronic circles in the 60's, saying, "The electronic tube is already out of date. It will be replaced by the transistor." "Hereafter, we will advance towards the age of 100% transistorization.", etc.

At home, there is also a tendency in recent years, in a number of departments, to go blindly, without analyzing, after¹ "an all-transistorization". And a saying that the so-called entire electronic technology can be divided into "the first generation electronic tubes, the second generation transistors, the third generation integrated circuits and the fourth generation large-scale integrated circuits" is rather prevalent.

Is this proposition correct? We hold that we must take the dialectical and not the metaphysical approach to this problem.

Chairman Mao taught us, "Without concrete analysis there can be no knowledge of the particularity of any contradiction. We must always remember Lenin's words, the concrete analysis of concrete conditions." In order to have a clear orientation in developing technology and to adopt² a correct technical policy, it is necessary to sum up the experiences and lessons at home and abroad, and analyze how to correctly handle the relation between the electronic tube and the semiconductor device of our country under the present conditions of the performance levels³ each has acquired respectively, so that we can design

1. go after: 追求. 2. to adopt: 采取. 这里是同前面的 to have 并列. in order to 为了. 3. levels: 后面省去了 that, 参看附录 7.

and turn out electronic equipment of better integrated performance and develop our electronic technology with more, faster, better and more¹ economical results. We hold that it is necessary to explore the question of how to correctly handle the relation between the semiconductor device and the electronic tube, especially at present when the semiconductor technology has already been given universal attention and is certain of a continuous expansion in a big way.

For this reason, we would like to give our opinions, for discussion, as follows:

Recall History, Study Status Quo

In order to analyze and compare the advantages and disadvantages of the two kinds of devices, it is necessary to recall the history of their development and study their status quo. The primitive semiconductor device actually occurred for the first time in 1895, as the crystal detector in the radio receiver. The vacuum diode invented² in 1904, owing to its excellent performance, was used in detection and rectification to replace the crystal detector. 1907 brought into being³ the vacuum triode which is capable of oscillation and amplification. They met the demands for⁴ long-distance radio communication, thus the vacuum tube began to develop at a swift tempo.

The appearance of radar at the beginning of the 40's brought the need for higher operating frequency and so promoted the

1. **more:** 加在 economical 前面构成 economical 的比较级, “更为节省的”。这 more 的作用同前面那个 more 不同, 前面那个是 many 的比较级 “更多的”。 2. **invented:** 过去分词, 作 diode 的定语. diode 的谓语是 was used. 3. **brought into being:** 实现, 使...产生. brought 是 bring 的过去时. 4. **met the demands for:** 满足对...的需要. met 是 meet 的过去时.

research and development of such microwave tubes as magnetrons and transit-time tubes. However, limited by its frequency, the vacuum diode could not meet the requirements of microwave detection. Then appeared in 1940 the microwave mixer and the detector diode made of silicon crystal with much better performance than the original vacuum diodes. Attention was again focussed on the semiconductor technology.

Later on, a great amount of research on such semiconductor materials as germanium and silicon resulted in the transistor in 1948, which is capable of amplification, thus making possible the miniaturization¹ of the whole machine and giving high reliability. Since then, the semiconductor device has begun to expand by leaps and bounds² and have found wide application in electronic equipment. The integrated circuit and the large-scale integrated circuit developed in recent years on the basis of the semiconductor technology have even more far-reaching significance to electronic equipment in further micro-miniaturization, reducing power consumption and raising reliability.

However, the viewpoint "one divides into two" can also be applied to the performance of both the semiconductor device and the electronic tube, just as it can to all other things. At present, generally speaking, the electronic tube, featured by high frequency, high power, high gain, wide band, resistance to high temperature and radiation, stability, etc., but is large, heavy and technically complicated, its auxiliary attachments large and it does not facilitate miniaturization of the machine. On the other hand, the semiconductor device is small, compact,

1. **making possible the miniaturization:** 使得小型化成为可能. make 的这种用法可参看附录 4. 2. **by leaps and bounds:** 迅猛地.

shockproof, highly reliable, technically simple and low cost; it requires no pre-heating and low operating voltage, and it facilitates miniaturization; however, due to the limitation of the size and cooling effect of the materials, the frequency and power cannot be raised easily and its stability and resistance to radiation are not satisfactory.

Therefore, where its power, frequency and other specific performance meet the requirements, the semiconductor device has, without exception, replaced the electronic tube in the application of general signal reception and amplification as well as logic circuits because it is small and compact, and has low power drain and long service life.

However, as far as high frequency, wide band, high power, visual display, etc. are concerned¹, we still see no possibility of the semiconductor replacing² the electronic tube in the near future by reason of the limitation in the semiconductor technical level and economic factors.

In the above two aspects, it is a publicly acknowledged and undisputed question that³ the semiconductor device and the electronic tube have each its own unique features and each occupies a place⁴ it deserves.

Whereas, in the sphere between the two, such as microwave band, when used as medium and small power oscillator and low noise receiving device (its range of application including airborne navigation equipment, electronic countermeasurer,

1. **as far as...are concerned**: 就...而论. 2. **replacing**: 取代, 是动名词, 作 of 的宾语, possibility of the semiconductor replacing the electronic tube 是“半导体取代电子管的可能性”. 3. **that**: 这里引的是主语从句. 前面的 it 是引词, 代表这 that 从句而处于主语位置, 不译成“它”. 4. **place**: 后面省去了 that. 参看附录 7.

phase array radar, etc.), both the semiconductor device and the electronic tube have advantages of their own. As for¹ which is more suitable to use, that is a question to be decided² in accordance with the specific performance requirements, working conditions, technical questions involved and economic factors, taking into account at the same time, their respective plus and minus³ and the local conditions. In this specific sphere, the two can only complement each other, there is no question, at present, of “the one being entirely replaced⁴ by the other”.

The Question of Reliability

Generally speaking, it is correct to say, “The semiconductor device has higher reliability than the electronic tube.” That is due to the fact that in a semiconductor device failure occurs mainly at the beginning, that is, within 8—300 hours after using, and it becomes stable thereafter. Whereas, in an electronic tube, early failure usually occurs within 20—30 hours after using, then there is a period of stable service, followed by constant increase in the rate of occasional failures. For this reason, after careful selection and stability adjustment, the semiconductor device may give higher reliability. However, we must see that the reliability of the whole machine not only depends on the reliability of the device itself, it is closely relevant to other factors, such as the technical level of manufacture, the working conditions and specific requirements.

Being⁵ more “robust”, the electronic tube has high resistance to over-load and can withstand bad conditions due to

1. as for: 至于. 2. to be decided: 有待于决定的(问题). to be 表示“要”“将”. 3. their respective plus and minus: 它们各自的优缺点. 4. being replaced: 取被代. 是动名词 replacing 的被动式. 5. being: 由于是. be 的分词.

careless handling or some other factors, and it can even continue operation after its performance deteriorates. The semiconductor device, on the contrary, is more “delicate”, and will cease to operate under slight changes in the working environment and under instantaneous H. V. surge. Consequently, the criterion of reliability should be based on the result of operation and practice. It is undesirable to draw simple conclusion in accordance with theoretical formula alone. We should take the experimental and analytic approach to the problem and determine concretely the degree of its reliability.

The Question of Progressiveness

What is the criterion of “advanced”? There is no denying that many of the “all-transistorized” electronic equipment are comparatively advanced. But, the integrated performance of some of the equipment, not few in number, has been lower as a result of “all-transistorization”. Such equipment is not necessarily advanced. For instance, in recent years, many countries abroad have overdone it in¹ going after miniaturization and “all-transistorization” in colour television, which² has resulted in many fire and electric shock accidents, thus reducing the safety of the products. Some “all-transistorized” measuring equipment do not perform as well as the original equipment in which electric tubes were used.

Therefore, we must take everything into consideration when making design and manufacturing. The only criterion of progressiveness in an electronic equipment is whether or not its integrated performance is good.

1. have overdone it in ...: 在...方面做过了头. overdone 是 overdo 的过去分词. 2. which: 这(就). 代指整个上文, 而不是代某个具体的名词.

In fact, the proposition of the so-called “the first generation electronic tubes, the second generation transistors, the third generation integrated circuits and the fourth generation large-scale integrated circuits” has practically no precise meaning in all other aspects of the electronic technology, except that it may serve as a marking at a certain stage of development of the electronic computer. And as far as electronic computer is concerned, this “changing of generations” can only be used in its arithmetic and control units as a demarcation line to show the degree of progressiveness in its technical level. Whereas, in the peripheral equipment, new type electronic tubes such as high determination flying spot scanner, multi-colour display tubes, dry printing tubes are adopted in great numbers in recent years to give high speed, high reliability, visual effect, etc.

The Incorporation and Interpenetration of the Two Kinds of Devices

It is worth noticing that¹ some advanced machine systems today adopt certain hybrid construction of the semiconductor device and the electronic tube.

For example, the power transformerless preamplifier and audio amplifier units made in our country is just such a hybrid construction combining ordinary electronic tubes with semiconductor devices. This simple construction is not at all² backward; on the contrary, it is featured by high reliability, light weight, low cost as compared with³ the “all-transistorized” audio amplifier. These units are welcomed by the broad

1. **It is worth noticing that:** 值得注意的是。 2. **not at all:** 全然不, 毫不, 并不。 3. **as compared with:** (这)比起...来,(这)较之。

masses and are being popularized rapidly. This new thing which has broken away from the conventional design concept is of great political as well as economical significance. Continuation to explore along this new idea of design will enable more electronic equipment (such as televisions, measuring instruments, communication equipment and broadcasting equipment) not only to do away with¹ the heavy and awkward power transformers safely and reliably but also to facilitate in making full use of the respective advantages of both the ordinary electronic tube and the semiconductor device, ensuring low cost and high quality. Such equipment is light, compact and reliable with² its integrated performance greatly raised. This will promote the rapid development of our broadcasting enterprises and our electronic industry.

Even abroad, electronic equipment have not been “all-transistorized” either, as some people might have thought. Take Japan, for example, whose semiconductor technology is comparatively advanced. Some high quality electronic tubes are still in use in high fidelity radios and stereosonic equipment adapting to special requirements. As for the American Apollo spaceship, magnetrons are adopted in the transmitting units of the beacon systems of the lunar module and the command module while semiconductors in the reception units. Being under the yoke of metaphysical approach to problems, some western electronic specialists have placed undue emphasis on the role played by the semiconductor and so³ have gone through

1. to do away with: 去掉, 甩掉. 2. with: 见附录 3. 3. and so: 从而. 参看附录 5A 的[注意].