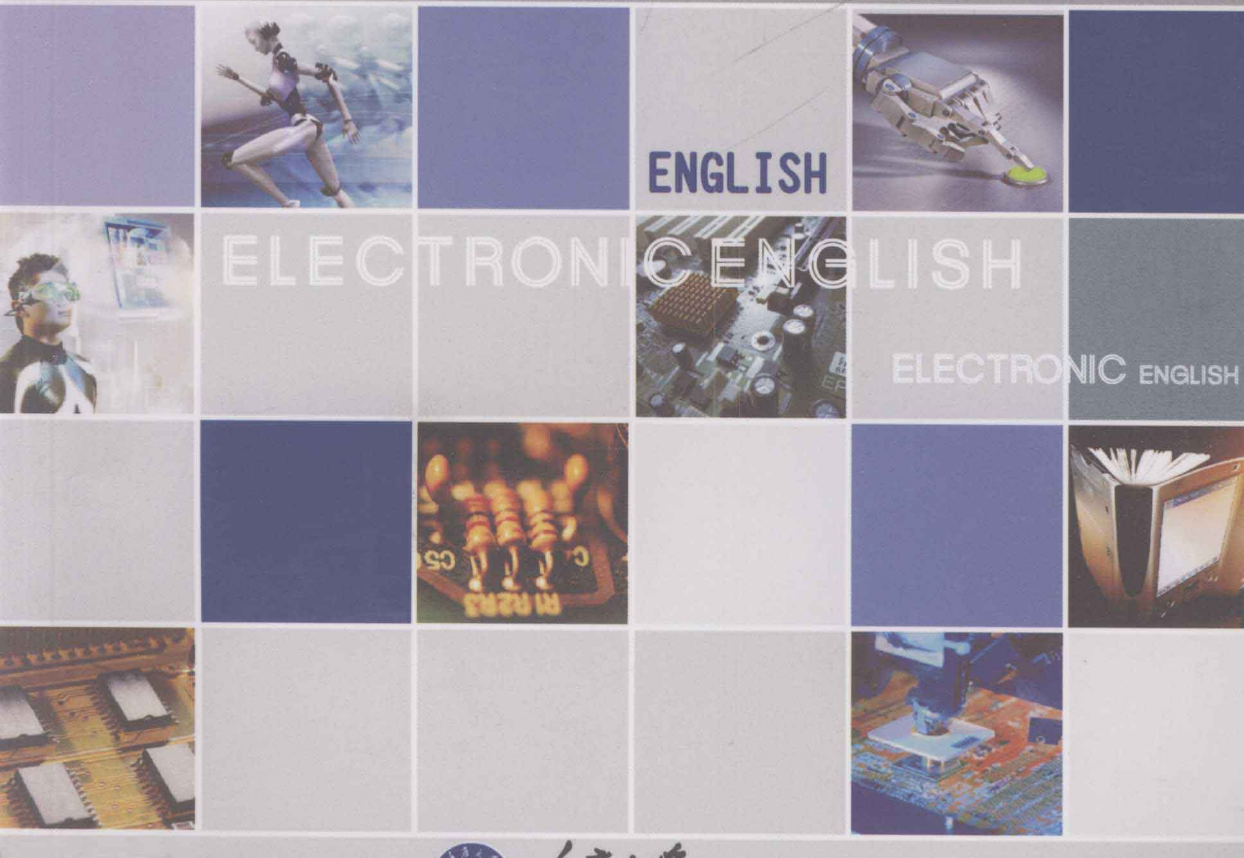
高职高专行业英语 ESP

电子英语

主 编 笪贤进



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电子英语

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内容提要

本书是一本很好的应用电子技术专业英语的教材，内容包括基本的电路分析原理、非常基础的模拟电子技术原理以及数字电子技术的入门知识。

本书内容在尽可能简洁清晰的原则下，介绍了与电子技术相关的英语知识，力争给学生打下一个阅读外文专业技术资料的基础。可作为大专院校以及本科院校的教学用书，也可供相关专业的工程技术人员学习和参考。

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前　言

电子技术的发展和计算机网络技术一样，从前的和现在的包括今后一段时间内的领舞者均为西方人，我们若想成为这个领域的领舞者，恐怕只有艰苦地努力、再努力……

迄今为止，大量第一手的电子技术方面的专业资料无疑是英文资料，谁替我们把它们翻译成母语呢？恐怕只有我们自己才是最可靠的人选。为此，我们在学习专业知识的同时，也要学习相关的英语。

本书的编写更多侧重于基础知识和基本概念，而不是一味地追求复杂和高度。有心的读者若是志在高远，那也得从点滴做起。

本书共分11个单元：

第一单元对电子技术做了一个简单的介绍，在补充材料里介绍了三种基本的半导体材料。

第二单元介绍基本电工电子领域中最为常见的元器件——电阻，在其中的补充阅读资料里提供了关于超导体的一些概念。

第三单元介绍电容器和电容的概念，电容器也是电子领域中最基本的元件之一。

第四单元介绍电感器和电感的概念，电感和电阻、电容一起，是电子技术专业学生最早接触的并且与其一生的事业息息相关的三个基本概念。

第五单元介绍基本电路分析所涉及的基本定理：基尔霍夫定律、戴维南定理、诺顿定理以及叠加原理等。这些知识是电子专业学生应该掌握的最根本性的知识！电路分析是分析一个电系统的功能和工作过程等，是电子专业学子从事工作的前提。

第六单元介绍半导体二极管，这是电子领域最有代表性的器件。电子时常被称为半导体电子。半导体从某种意义上讲算得上是电子的灵魂。现代电子产品包括所谓的计算机，涉及分量最重的绝对是半导体。但是，由于半导体是一种非线性器件，对它的分析，远不像分析电阻电路那么简单，所以这部分内容放在了基本电路分析理论的后面。

第七、八两个单元讨论的是半导体三极管的基本知识，包括静态工作点的概念以及基本放大器的工作原理。这是模拟电子技术的根本内容，虽然简单，但却是电子工

程师的根。

最后3个单元则重点介绍了数字电子技术的入门知识。

为了培养广大学子在电子专业领域能够熟练阅读英文资料，本书参考了英美原版电子教材。

鉴于编者水平所限，再加上电子技术的发展已经触及到我们生活的方方面面，电子技术的难度、深度难以把握，所以不足之处定然存在。希望广大读者不吝指教，笔者将欣然接受并不断改进。

编　者

2010年6月

CONTENTS

Unit One An Introduction to Electronics

After reading this unit and completing the exercises, you will be able to

☆ Describe the objective of this book.

☆ Describe how little the fundamental principles of electronics change over these years.

☆ Explain what is most important in learning electronics.

Lead-in

1. ***Look at the pictures and discuss about them. Then write down the relevant terms and expressions in the space below.***

Typical integrated circuit(shown on a fingernail)

A silicon chip in modern computers

2. ***Read the following passage with the questions below to think about.***

   (1) Describe the basic characteristics of electronics.

   (2) Describe what limits the further miniaturization in intergrated circuit.

Time to Read It

The objective of this book is to present some methods of reading articles about electronic systems, and more importantly, to lay a solid foundation for our students' future career in electronics. [1] One of the noteworthy things in this field, as in many other areas of technology, is how little the fundamental principles change over time. Systems are incredibly smaller and smaller, current operating speeds are truly remarkable, and new gadgets appear every day, leaving us to wonder where technology is taking us. [2] However, if we take a moment to consider that the majority of the devices in use were invented decades ago and that some design techniques appearing in the textbooks as far back as the 1930s are still in use, we will realize that most of what we see is primarily a steady improvement in processing techniques and new appplications of those obsolete devices rather than the development of new components and fundamentally new designs. [3] The result is that most of the devices discussed today have been around for some time, and that the texts on the subject written a decade ago are still good references with contents that have not changed a lot. The major changes have been in the understanding of how these devices work and how to realize their full range of capabilities, and in improved methods for teaching the fundamentals associated with them. The benefit of this book to the beginners in this subject is that all the materials in the book are relatively easy to grasp and the information will be put into application for years to come.

The miniaturization that has occurred in recent years leaves us to wonder about its limits. The complete systems now appearing on wafers are thousands of times smaller than the single elements of earlier networks. The first intergrated circuit (IC) was developed by Jack Kilby while he was working at Texas Instruments in 1958. Today, the Intel® Pentium® 4 processor has more than 42 million transistors and a host of other components. Recent advances suggest that 1 billion transistors will soon be placed on a sliver of silicon smaller than a fingernail. We have obviously reached a point where the primary purpose of a container is simply to provide some means for handling the device or the system and to provide a mechanism for attachment to the remainder of the network. Further miniaturization appears to be limited by three factors: the quality of the semiconductor material, the network design technique, and the limits of the manufacturing and processing equipment.

The most fundamental device in electronics is semiconductor, and the simplest thing we should understand firstly is the semiconductor materials. At the same time we should realize that the simplest is the most important.

Moreover, we should understand that semiconductor diode, almost the simplest device in electronics, is a nonlinear device; it is important to clarify that in order to use a nonlinear device correctly, you should be familiar with linear devices. For this reason, we will introduce linear devices firstly, and then recall those basic theories about linear electric circuits (from Unit 2 to Unit 5). With these foundations, we will go ahead to learn more about nonlinear semiconductor devices.

• *Words and Expressions* •

1. electronics	[ilek'trɔniks]	*n.*	电子学
2. noteworthy	['nəutwəːði]	*a.*	显著的;值得注意的
3. fundamental	[ˌfʌndə'mentl]	*a.*	基础的;根本的
4. current	['kʌrənt]	*a.*	现在的;当前的
5. gadget	['gædʒit]	*n.*	小机件;(小巧的)器具;小玩意儿
6. miniaturization	[ˌminiətʃərai'zeiʃən]	*n.*	小型化;微型化
7. wafer	['weifə]	*n.*	【电】晶片
8. Pentium		*n.*	【电脑】美国英特尔(Intel)公司生产的微处理器(586 CPU)
9. transistor	[træn'zistə]	*n.*	晶体管
10. host	[həust]	*n.*	[C]许多,大量
11. sliver	['slivə]	*n.*	薄片,小块
12. fingernail	['fiŋgəneil]	*n.*	手指甲
13. container	[kən'teinə]	*n.*	容器
14. handle	['hændl]	*v.*	操纵
		n.	[C]柄,把手;柄状物
15. attachment	[ə'tætʃmənt]	*n.*	连接;安装;附着(~to)
16. semiconductor	[ˌsemikən'dʌktə]	*n.*	【物】半导体
17. clarify	['klærifai]	*vt.*	阐明;澄清
18. recall	[ri'kɔːl]	*vt.*	回想,回忆;使想起

● Notes ●

1. ... lay a solid foundation for our students' future career in electronics.
为同学们将来的电子技术事业打下一个坚实的基础。
2. Systems are incredibly smaller and smaller, current operating speeds are truly remarkable, and new gadgets appear every day, leaving us to wonder where technology is taking us.
系统越来越小巧,工作的速度异常快速,新的器件不断出现,让我们(不得不)猜想(当代)技术将把我们领向何处。
3. However, if we take a moment to consider that the majority of the devices in use were invented decades ago and that some design techniques appearing in the textbooks as far back as the 1930s are still in use, we will realize that most of what we see is primarily a steady improvement in processing techniques and new appplications of those obsolete devices rather than the development of new components and fundamentally new designs.
然而,如果我们花点时间来考虑如今正在广泛使用的绝大部分器件都是几十年前发明的,并且早在20世纪30年代的教材里出现的设计技术今天仍然被采用,我们就会意识到今天我们所见到的不过是加工技术方面的进步以及那些老器件的一些新的应用,而不是新的元器件以及新的基本设计技术的研发。

● Activities ●

1. Complete the following sentences according to the passage above.

(1) The major changes have been in the understanding of how these devices work and how to realize their __________ of capabilities, and in improved methods for teaching the fundamentals associated with them.

(2) The __________ that has occurred in recent years leaves us to wonder about its limits.

(3) Today, the Intel® Pentium® 4 processor has more than 42 million transistors and a __________ of other components.

(4) The most fundamental device in electronics is __________.

2. Translate the following sentences into English.

(1) 在电子技术领域里,我们首先要了解的最简单的事物就是半导体材料。

(2) 当然,我们应该了解二极管,它也许是电子技术里最简单的器件。

(3)要想正确使用非线性器件,你得先熟悉线性器件,这一点是非常重要的。

(4)结果是:今天所讨论的绝大部分器件其实已经问世相当长时间了,而且十多年前所写的相关课本至今仍然是很好的参考书,其内容也未有大的改动。

(5)当然,所涉及的器件主要都是非线性半导体器件。

Further Reading

Semiconductor Materials: Ge, Si, and GaAs

The construction of every discrete solid-state electronic device or integrated circuit begins with a semiconductor material of the highest quality. Semiconductors are a special class of elements having a conductivity between that of a good conductor and that of an insulator.

In general, semiconductor materials fall into two classes: single-crystal and compound. Single-crystal semiconductors such as germanium (Ge) and silicon (Si) have a repetitive crystal structure, whereas compound semiconductors such as gallium arsenide (GaAs) and cadmium sulfide (CdS) are constructed of two or more semiconductor materials of different atomic structures.

The three semiconductors used most frequently in the construction of electronic devices are Ge, Si, and GaAs.

In the first few decades following the discovery of the diode in 1939 and the transistor in 1947, germanium was used almost exclusively because it was relatively easy to find and was available in fairly large quantities. It was also relatively easy to refine for very high levels of purity, an important aspect in the fabrication process. However, it was discovered in the following years that diodes and transistors using germanium as their base materials suffered from low levels of reliability primarily due to its sensitivity to changes in temperature. At the time, scientists were aware that another material, silicon, had improved temperature sensitivities, but the refining process for manufacturing silicon with very high levels of purity was still in the development stages. Finally, however, since the first silicon transistor was introduced in 1954, silicon quickly became preferred semiconductor material. Not only is silicon less temperature sensitive, but it is one of the most abundant materials on the earth. The flood gates are now opened to this new material, and the manufacturing and design technology has been improved steadily through several years, reaching the current high level of sophistication.

As time moved on, however, the field of electronics became increasingly sensitive to issues of speed. Computers were operating at higher and higher speeds, and communication systems were operating at higher levels of performance. A semiconductor material able to meet these new needs had to be found. As a result, the first GaAs transistor was developed in the early 1970s. This new transistor had speeds of operation up to five times that of Si. The problem, however, was that because of the improvments in designing and manufacturing Si through these years' efforts, Si transistor networks for most applications were cheaper to manufacture and had the advantage of highly efficient design strategies. GaAs was more difficult to manufacture at high levels of purity, was more expensive, and had little design support in its early years of development. However, the demand for increased speed resulted in more funding for GaAs research, to the point that today it is consistently used as the base material for new high-speed, very large scale integrated circuit designs.

• New Words •

1. germanium	[dʒəːˈmeiniəm]	*n.*	【化】锗
2. gallium	[ˈgæliəm]	*n.*	【化】镓
3. arsenide	[ˈɑːsənaid]	*n.*	【化】砷化物
4. cadmium	[ˈkædmiəm]	*n.*	【化】镉
5. sulfide	[ˈsʌlfaid]	*n.*	【化】硫化物
6. fabrication	[ˌfæbriˈkeiʃən]	*n.*	制造;组建

Unit Two Resistors and Superconductors

After reading this unit and completing the exercises, you will be able to

☆ Define the resistance of a resistor.

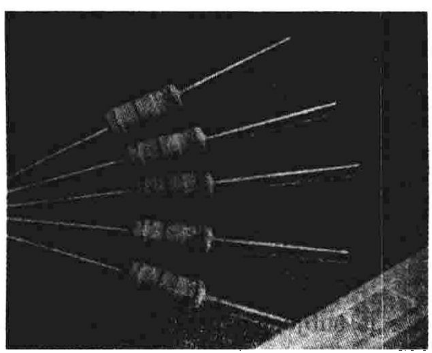
☆ Describe the basic factors affecting the resistance in a common conductor.

☆ Explain how a common conductor dissipates energy.

☆ Describe the basic characteristics of superconductors.

Lead-in

1. ***Look at the picture and discuss about it. Then write down the relevant terms and expressions in the space below.***



Resistor

2. ***Read the following passage with the questions below to think about.***

   (1) How to calculate the resistance of a section of conductor, given its cross-sectional area and length?

   (2) Describe why there is no energy loss in superconductors.

Time to Read It

Though we know that semiconductor is the most popular device in electronics, electronic circiut cannot be analysized without general circuit theories. [1] Resistance, capacitance, and inductance, however, are the three basic circuit properties that we use to control voltages and currents in general circuits. Each of these three circuit properties behaves in a fundamentally different way. Resistance, for example, opposes current, while capacitance opposes any change in voltage, and inductance opposes any change in current. [2] In addition, resistance dissipates energy, while capacitance and inductance both store energy—capacitance in its electric field and inductance in its magnetic field.

Circuit elements that are built to possess capacitance are called capacitors, while elements built to possess inductance are called inductors. In this unit, we put the emphasis on resistor, its properties, and its behaviour in circuits.

Resistance of Conductors

It is well known that conductors are materials which permit the flow of charge. [3] However, not all conductors behave the same way. Rather, we find that the resistance of a material is dependent upon four factors:

- Type of material
- Length of the conductor
- Cross-sectional area
- Temperature

If a certain length of wire is subjected to a current, the moving electrons will collide with other electrons within the material. [4] Differences at the atomic level of various materials cause variation in how the collisions affect resistance. [5] For example, silver has more free electrons than copper, so the resistance of a silver wire will be less than that of a copper wire with the identical dimensions. We may therefore make the following conclusion:

The resistance of a conductor is dependent upon the type of material.

If we double the length of the wire, we can expect that the number of collisions over the length of the wire will double, thereby causing the resistance to double accordingly. This effect may be summarized as follows:

The resistance of a metallic conductor is directly proportional to the length of the conductor.

Another property of a conductor somewhat less intuitive is the effect of cross-sectional area on the resistance. As the cross-sectional area is increased, the moving electrons are able to move more freely through the conductor, just as water moves more freely through a large-diameter pipe than a small-diameter pipe. If the cross-sectional area is doubled, only half as many electrons would be involved in collisions over the length of the wire. We may summarize this effect as follows:

The resistance of a metallic conductor is inversely proportional to the cross-sectional area of the conductor.

The factors governing the resistance of a conductor at a given temperature may be summarized mathematically as follows:

$$R = \frac{\rho \ell}{A} [\text{ohm}, \Omega]$$

Where

$\rho =$ resistivity, in ohm-meters($\Omega - \text{m}$)

$\ell =$ length, in meters(m)

$A =$ cross-sectional area, in sequre meters (m^2)

In the above equation the lowercase Greek letter rho (ρ) is the constant of proportionality and is called the resistivity of the material. Resistivity is a physical property of a material and is measured in ohm-meters($\Omega - \text{m}$) in the SI system. The resistivity of a kind of material is often affected by the temperature.

Example 2-1 Most homes use solid copper wire with a diameter of 1.63 mm to provide electrical distribution to outlets and light sockets. Determine the resistance of 75 meters of a solid copper wire having the above diameter. (The resistivity of solid copper is $1.723 \times 10^{-8} \Omega - \text{m}$)

Solution We will first calculate the cross-sectional area of the wire using the following equation:

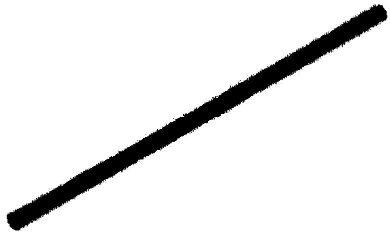


Figure 2-1 Solid copper wire

$$A=\frac{\pi d^2}{4}=\frac{\pi(1.63\times10^{-3}\text{m})^2}{4}=2.09\times10^{-6}\text{m}^2$$

Now, the resistance of a 75 m length of wire is found as

$$R=\frac{\rho\ell}{A}=\frac{(1.723\times10^{-8}\Omega-\text{m})(75\text{ m})}{2.09\times10^{-6}\text{m}^2}=0.619\ \Omega$$

• *Words and Expressions* •

1. resistance	[ri'zistəns]	*n.*	【电】电阻
2. capacitance	[kə'pæsitəns]	*n.*	【电】电容,电流容量
3. inductance	[in'dʌktəns]	*n.*	【电】电感;感应系数
4. dissipate	['disipeit]	*vt.*	驱散(雾等),使消散;消除,使消失
5. capacitor	[kə'pæsitə]	*n.*	【电】电容器
6. inductor	[in'dʌktə]	*n.*	【电】感应器
7. resistor	[ri'zistə]	*n.*	电阻器
8. charge	[tʃɑːdʒ]	*n.*	【电】电荷
9. to be subjected to			遭受,承受
10. electron	[i'lektrɔn]	*n.*	【电】电子
11. metallic	[mi'tælik]	*a.*	金属的;金属制的
12. intuitive	[in'tjuːitiv]	*a.*	直觉的;直观的
13. lowercase	['ləuə'keis]	*n.*	小写字母
14. constant	['kɔnstənt]	*n.*	【数】常数,常量
15. proportionality	[prəuˌpɔːʃə'næliti]	*n.*	比例(性);均衡(性)
16. resistivity	['riːzis'tiviti]	*n.*	【电】电阻率
17. outlet	['autlet]	*n.*	[C]电源插座

18. socket ['sɔkit] *n.* [C]【电】灯座,插座;插口

• *Notes* •

1. Though we know that semiconductor is the most popular device in electronics, electronic circiut cannot be analysized without general circuit theories.
   虽然我们知道半导体是电子技术领域最常用的器件,但是若没有普通的电路原理理论基础,是无法(准确地)分析电路的。
2. Resistance, for example, opposes current, while capacitance opposes any change in voltage, and inductance opposes any change in current.
   比如:电阻阻止电流,而电容阻止电压的变化,电感阻止电流的变化。
3. It is well known that conductors are materials which permit the flow of charge.
   (一般)都知道导体是一种允许电荷在其中流动的材料。
4. If a certain length of wire is subjected to a current, the moving electrons will collide with other electrons within the material.
   如果一段电线中流过一股电流,那么移动的电子将会与电线材料内部的电子相互碰撞。
5. Differences at the atomic level of various materials cause variation in how the collisions affect resistance.
   不同材料的原子结构不同将会造成(上述碰撞)对各自电阻产生不同的影响。

• *Activities* •

1. Complete the following sentences according to the passage above.

(1) The resistance of a conductor is ________ the type of material.

(2) If we double the length of the wire, we can expect that the number of collisions over the length of the wire will ________.

(3) Another property of a conductor, somewhat less ________ is the effect of cross-sectional area on the resistance.

(4) The resistance of a metallic conductor is ________ proportional to the cross-sectional area of the conductor.

2. Translate the following sentences into English.

(1) 电阻、电容和电感是三种最基本的电路元件。