高等教育“十二五”规划教材
装备制造行业自主创新人才培养推荐教材

机电专业英语

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内容简介

本书主要内容包括电路、电机学、自动控制、电气测量技术、可编程逻辑控制器、传感器、机器人技术、机械零件、机床、数控技术。共分为18个单元，每个单元配有课文、主要词汇注释和练习，方便读者学习机电专业英语技能。

本书具有专业性和实用性强，难度适宜等特点。适合作为机电一体化、数控、电气工程及其自动化、电子等相关专业的专业英语教材，也可供相关工程技术人员参考。

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前　言

本书主要内容涵盖了电路、电机学、自动控制、电气测量技术、可编程逻辑控制器、传感器、机器人技术、机械零件、机床、数控技术等，分为18个单元。书中内容是按每个单元用2学时授课的计划安排的，每个单元后都配有主要的词汇注释和练习等内容。

本书具有专业性和实用性强、难度适宜等特点，有助于培养学生阅读机电类英文资料的能力。本书可作为机电一体化、数控、电气工程及其自动化、电子等相关专业的专业英语教材，也可作为相关专业工程技术人员的参考用书。

本书由吉林铁道职业技术学院岳殿霞、张辉担任主编，吉林铁道职业技术学院刘振波、张青青、侯晓音、陈洪军担任副主编。其中Text 1、Text 2及“译文与答案”由岳殿霞编写，Text 3、Text 5、Text 6、Text 7由张辉编写，Text 11、Text 13、Text 16由刘振波编写，Text 4、Text 14、Text 15由张青青编写，Text 8、Text 9、Text 10由侯晓音编写，Text 12、Text 17、Text 18由陈洪军编写。

由于编者水平有限，书中疏漏在所难免，恳请广大读者和专家批评指正。

编　者

2014年3月

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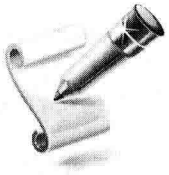


Electronic Components

An electronic component is a basic electronic element and may be available in a discrete form having two or more electrical terminals (or leads). These are intended to be connected together, usually by soldering to a printed circuit board, in order to create an electronic circuit with a particular function (for example, an amplifier, radio receiver, or oscillator). Basic electronic components (Figure1-1) may be packaged discretely (such as resistances, capacitances, or diodes), or integrated inside of packages (such as semiconductor integrated circuits).

Buttons

Buttons are sometimes known as button switches for the purpose of turning on/off the control circuits and an apparatus for sending command in electric driving.

The button can basically be classified as stop button, start button and compound button related to the application and the configuration of its contacts.

Low-voltage Switches

The switches are mainly divided into knife switches, combination switches and air circuit breakers.

In most cases, they are applied to be a power switch of the machine tools and a control switch in the local lighting circuit.

Knife Switches. There are several varieties of knife switches, in which knife switches and iron cover switches are the most common types.

Combination Switches. Combination switches are mainly applicable to the control circuit of machine tools for manually controlling the start-up and normal-reversible rotation of motor intermittently with small capacity under 5 kW.

Automatic Air Switches. The switches are also called air circuit breakers and mainly adopted to turn on or off the circuit infrequently as well as control the motor. In case of trouble, such as short

circuit, overload and voltage loss, automatic air switches can auto-disconnect the faulty circuit for protection.

Transformers

Transformers are used to increase or decrease AC voltages, Which are two coils of wire linked by an iron core. There is no electrical connection between the coils. Energy is transferred between the coils by the magnetic field in the core.

Fuses

Fuses are primary applicable to protect the short-circuit in low-voltage distribution circuit. Porcelain plug fuses and screw fuses are the two representative types.

AC Contactors

AC contactors are kinds of auto-control electric apparatus, which are applied to turn on/off the AC main circuit and control circuit with large capacity by completion of frequent remote control. They perform as low-voltage and non-voltage protections and are used chiefly where they are desired to control the motor as well as other loads.

Relays

Relays are the most versatile electric apparatus available, which switch on/off to realize the automatic control with the conversion of the input signal.

Relays can be categorized as thermo relay, time relay, speed relay, and intermediate relay.

Inductance

In electromagnetism and electronics, inductance is the ability of an inductor to store energy in a magnetic field. Inductance generate an opposing voltage proportional to the rate of change in current in a circuit. This property also is called self-inductance to discriminate it from mutual inductance, describing the voltage induced in another electrical circuit by the rate of change of the electric current in one circuit.

Capacitance

In electromagnetism and electronics, capacitance is the ability of a capacitor to store energy in an electric field. Capacitance is also a measure of the amount of electric potential energy stored (or separated) for a given electric potential. A common form of energy storage device is a parallel-plate capacitor. In a parallel plate capacitor, capacitance is directly proportional to the surface area of the conductor plates and inversely proportional to the separation distance between the plates.

Diode

A diode is a type of two-terminal electronic component. The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction), while blocking current in the opposite direction (the reverse direction). Thus, the diode can be thought of as an electronic version of a check valve. This unidirectional behavior is called rectification, and is used to convert alternating current to direct current.

Bipolar (Junction) Transistor

A bipolar (junction) transistor (BJT) is a three-terminal electronic device constructed of doped semiconductor material and may be used in amplifying or switching applications.

Resistance and Conductance

The resistors are made from carbon mixtures, metal films, or resistance wire and have two connecting wires attached. The electrical resistance of an electrical element is the opposition to the passage of an electric current through that element; the inverse quantity is electrical conductance, the ease at which an electric current passes. The SI unit of electrical resistance is the ohm (Ω), while electrical conductance is measured in siemens (S).

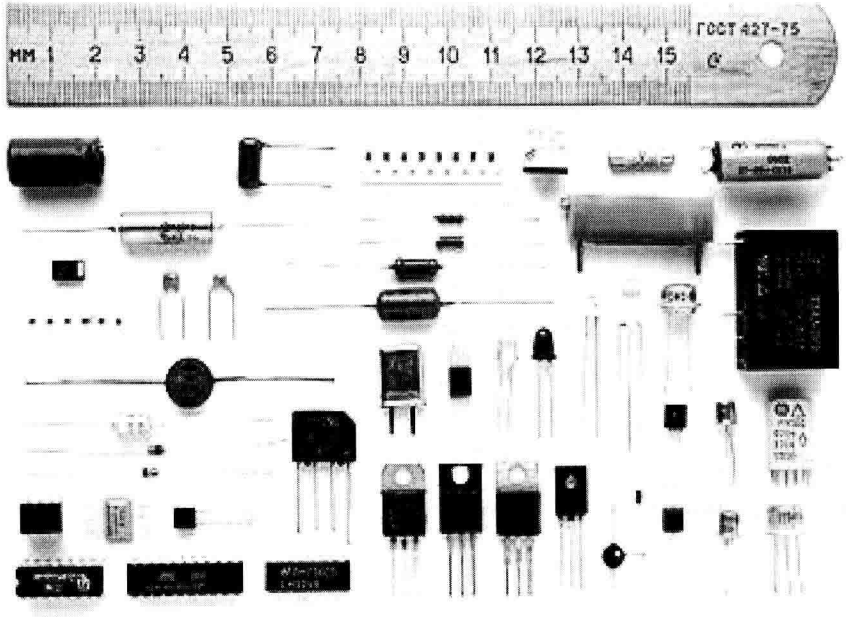
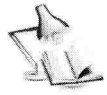


Figure 1-1 Various electronic components

Technical Words and Expressions

terminal	*n.*	电极，端子，接头
package	*vt.*	包装，封装
button	*n.*	按钮（开关），电钮，（桨的）插扣
apparatus	*n.*	器具，装置，设备，机器，器械，仪器
compound	*vt.*	使混合，调合，配合，复合，合成
configuration	*n.*	结构，构造，外形，组合，配置
contact	*n.*	触头，触点
switch	*n.*	开关，电闸，电键，转换器
combination	*n.*	组合，结合，合并，混合，联合，配合
local	*adj.*	局部的
iron	*adj.*	铁的，铁制的
applicable	*adj.*	合适的，适当的，能应用的
intermittently	*adj.*	间断的，周期性的
overload	*n.*	超负荷，过载
fuse	*n.*	保险丝，熔断器
porcelain	*adj.*	瓷（器）的
contactor	*n.*	接触器，开关
remote	*adj.*	遥远的，遥控的
relay	*n.*	继电器
inductance	*n.*	电感，感应现象
magnetic	*adj.*	磁（性）的，（可）磁化的
capacitance	*n.*	电容，电容器
parallel	*adj.*	同一方向的，平行的，并联的
diode	*n.*	二极管
valve	*n.*	阀，汽门
resistance	*n.*	电阻，阻抗，电阻器
electrical conductance		电导
bipolar (junction) transistor		双极晶体管



Exercises

Ⅰ. Translate the following sentences into Chinese.

1. The button can basically be classified as stop button, start button and compound button related to the application and the configuration of its contacts.
2. In case of trouble, such as short circuit, overload and voltage loss, automatic air switches can auto-disconnect the faulty circuit for protection.
3. In most cases, they are applied to be a power switch of the machine tool and the control switch of the machine tool and the control switch in the local lighting circuit.
4. Fuses are primary applicable to protect the short-circuit in low-voltage distribution circuit. Porcelain plug fuses and screw fuses are the two representative types.
5. Combination switches are mainly applicable to the control circuit of machine tools for manually controlling the start-up and normal-reversible rotation of motor intermittently with small capacity under 5 kW.

Ⅱ. Mark the following statements with T (true) or F (false) according to the text.

1. The most common function of a diode is to allow an electric current to pass in one direction, while blocking current in the opposite direction.
2. A bipolar (junction) transistor (BJT) is a two-terminal electronic device constructed of doped semiconductor material and may be used in amplifying or switching applications.
3. A common form of energy storage device is a parallel-plate capacitor.
4. Relays are the most versatile electric apparatus available, which switch on/off to realize the automatic control with the conversion of the output signal.
5. AC contactors perform as low-voltage and non-voltage protections and used chiefly where it is desired to control the motor as well as other loads.

Ⅲ. Complete the following sentences.

A diode is a type of _____ electronic component. The most common _____ of a diode is to allow an _____ current to pass in one direction (called the diode's forward direction), while _____ current in the opposite direction (the reverse direction). Thus, the diode can be thought of as an electronic _____ of a check valve. This unidirectional behavior is called _____, and is used to convert _____ current to direct current.

READING MATERIALS

(A) Electrical Engineering

As early as the latter part of the 16th century, experimenters were exploring the behavior of static electricity. W. Gilbert experimented with electric charges and discharges. In 1750 Benjamin Franklin proved that lightning was electrical in nature. Neither investigator discovered anything that was significant from the standpoint of the applications of electricity. Discovery of the presence of magnetism in certain rocks preceded the earliest knowledge of electricity. Such knowledge was common about 600 B. C.. Applications of electrical knowledge were completely absent in this era.

In 1,800 A. Volta discovered the principle of the electric battery. The voltaic cell was one of the most important discoveries in the history of the electrical art, because it provided a continuous source of appreciable amounts of electric power at reasonably low voltage. It was an essential component of the early communication systems, such as the telephone and telegraph.

The first United States' patent on the electrical telegraph was obtained by J. Groat in 1,800. The invention of a practical electromagnet was announced by Joseph Henry in 1827. These inventions by Groat and Henry opened the way for a still more significant invention, the electromagnetic telegraph. The principle of this forerunner of the communications industry was conceived in 1831, proven practical in 1837, and patented 1840 by Samuel. F. B. Morse.

Few developments have had greater impact on American life than Morse's invention. His idea paved the way for the first system of electrical communication, the telegraph. This in turn led to the telephone and later to the wireless telegraph.

The discovery of electromagnetic induction by Michael Faraday in 1831 established many principles for modern machines. Motors, generators, transformers, and many other electrical devices found in heavy electrical industry were made possible by the discoveries of Faraday. The contributions of Faraday in the electrical power industry are comparable to those of Morse in the field of communications.

One of the first important developments based on the disclosures of Faraday was the electric dynamo. English patent No.1858 describes the principle of operation. In the following years many types dc generators were developed and used commercially. The Gramme-ring armature was one of the first used in conjunction with a commutator. This machine was somewhat inefficient, but it provided a source of relatively high voltage at a reasonably large power capacity (up to 100 kW).

With the development of the high-resistance carbon filament lamp by Thomas Edison in 1880, the dc generator became one of the essential components of the constant-potential lighting system. Commercial lighting and residential lighting became practical and the electric light and power

industry was born. One of the most common uses for direct current during this period was for street lighting.

The first transformer was announced in 1883. This device probably did more to revolutionize the systems of power transmission than any other. The advantages of high-voltage low-current systems over the low-voltage high-current systems of power transmission were well known. Following the discovery of the transformer, power could be generated at low voltages, transformed to higher voltages for transmission over great distances (several hundred miles), and then reduced by transformers to lower values for utilization.

Since 1945 great advances have been made as the result of the invention of the transistor. This solid-state device has made possible the miniaturization of many components, integrated circuits, and calculators. During this same period, research in electron optics has preceded the development of lasers and holography.

The rate of growth of research in electrical engineering was enhanced in the 1940s as a result of support of Federal agencies. Many ideas associated with the military effort of that period are now being used commercially and for research purposes. Microwaves have become part of modern communication systems. The development of semiconductors has made possible more rugged, smaller, and cheaper systems. Research in miniaturization has greatly increased the speed of modern computers. The laser has provided communication systems operative over millions of miles. Integrated circuits have reduced size and weights and made practical interplanetary and satellite communications. Planetary radar astronomy and radio astronomy are also the result of adaptations to engineering systems of electrical components developed through research.

(B) Waveguide

A waveguide (Figure 1-2) is a structure which guides waves, such as electromagnetic waves or sound waves. There are different types of waveguides for each type of wave. The original and most common meaning is a hollow conductive metal pipe used to carry high frequency radio waves, particularly microwaves.

Waveguides differ in their geometry which can confine energy in one dimension such as in slab waveguides or two dimensions as in fiber or channel waveguides. In addition, different waveguides are needed to guide different frequencies: an optical fiber guiding light (high frequency) will not guide microwaves (which have a much lower frequency). As a rule of thumb, the width of a waveguide needs to be of the same order of magnitude as the wavelength of the guided wave.

There are structures in nature which act as waveguides: for example, the SOFAR channel layer in the ocean can guide whale song enormous distances.

Waves in open space propagate in all directions, as spherical waves. In this way they lose their power proportionally to the square of the distance; that is, at a distance R from the source, the power

is the source power divided by R^2. The waveguide confines the wave to propagation in one dimension, so that (under ideal conditions) the wave loses no power while propagating.

Waves are confined inside the waveguide due to total reflection from the waveguide wall, so that the propagation inside the waveguide can be described approximately as a "zigzag" between the walls. This description is exact for electromagnetic waves in a hollow metal tube with a rectangular or circular cross section.

The first structure for guiding waves was proposed by J. J. Thomson in 1893, and was first experimentally tested by Oliver Lodge in 1894. The first mathematical analysis of electromagnetic waves in a metal cylinder was performed by Lord Rayleigh in 1897. For sound waves, Lord Rayleigh published a full mathematical analysis of propagation modes in his seminal work, "The Theory of Sound".

The study of dielectric waveguides (such as optical fibers, see below) began as early as the 1920s, by several people, most famous of which are Rayleigh, Sommerfeld and Debye. Optical fiber began to receive special attention in the 1960s due to its importance to the communications industry.

The uses of waveguides for transmitting signals were known even before the term was coined. The phenomenon of sound waves guided through a taut wire have been known for a long time, as well as sound through a hollow pipe such as a cave or medical stethoscope. Other uses of waveguides are in transmitting power between the components of a system such as radio, radar or optical devices. Waveguides are the fundamental principle of guided wave testing (GWT), one of the many methods of non-destructive evaluation.

Specific examples:

- Optical fibers transmit light and signals for long distances and with a high signal rate.
- In a microwave oven a waveguide transfers power from the magnetron where waves are formed, to the cooking chamber.
- In a radar, a waveguide transfers Radio Frequency energy to and from the antenna, where the impedance needs to be matched for efficient power transmission (see below).
- A waveguide called stripline can be created on a printed circuit board, and is used to transmit microwave signals on the board. This type of waveguide is very cheap to manufacture and has small dimensions which fit inside printed circuit boards.
- Waveguides are used in scientific instruments to measure optical, acoustic and elastic properties of materials and objects. The waveguide can be put in contact with the specimen (as in a Medical ultrasonography), in which case the waveguide ensures that the power of the testing wave is conserved, or the specimen may be put inside the waveguide (as in a dielectric constant measurement[6]), so that smaller objects can be tested and the accuracy is better.

Waveguides used at optical frequencies are typically dielectric waveguides, structures in which a dielectric material with high permittivity, and thus high index of refraction, is surrounded by a

material with lower permittivity. The structure guides optical waves by total internal reflection. An example of an optical waveguide is optical fiber.

Other types of optical waveguide are also used, including photonic-crystal fiber, which guides waves by any of several distinct mechanisms. Guides in the form of a hollow tube with a highly reflective inner surface have also been used as light pipes for illumination applications. The inner surfaces may be polished metal, or may be covered with a multilayer film that guides light by Bragg reflection (this is a special case of a photonic-crystal fiber). One can also use small prisms around the pipe which reflect light via total internal reflection — such confinement is necessarily imperfect, however, since total internal reflection can never truly guide light within a lower-index core (in the prism case, some light leaks out at the prism corners).

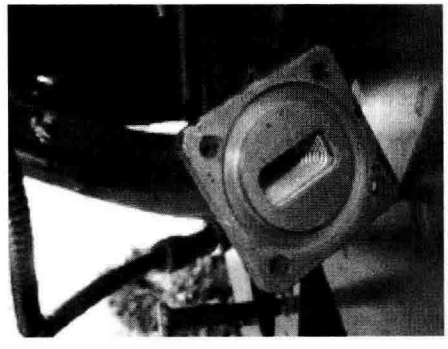
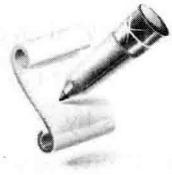


Figure 1-2 A section of flexible waveguide with a pressurizable flange

Text 2



Integrated Circuits

Integrated circuits (Figure 2-1) are used in virtually all electronic equipment today and have revolutionized the world of electronics. Sharp size weight reductions are possible with these techniques; and more importantly, high reliability, excellent functional performance, low cost and low power dissipation can be achieved. Integrated Circuits are widely used in the electronic industry. Computers, mobile phones, and other digital appliances are now inextricable parts of the structure of modern societies, made possible by the low cost of production of integrated circuits.

Integrated Circuits are usually called ICs or chips. Integrated circuit is a combination of a few interconnected circuit elements such as transistors, diodes, capacitors and resistors produced in a single manufacturing process on one and the same bearing structure called the substrate, and intended to perform definite function involved in converting information.

Integrated circuits can be classified into analog, digital and mixed signal (both analog and digital on the same chip). The digital integrated circuits are employed mostly in computers, electronic counters, frequency synthesizers and digital instruments. And the analog, or linear integrated circuits operate over a continuous range, and include such devices as operational amplifiers.

Digital integrated circuits can contain anything from one to millions of logic gates, flip-flops, multiplexers, and other circuits in a few square millimeters. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. These digital ICs, typically microprocessors, DSPs, and micro controllers, work using binary mathematics to process "one" and "zero" signals.

Analog ICs, such as sensors, power management circuits, and operational amplifiers, work by processing continuous signals. They perform functions like amplification, active filtering, demodulation, and mixing.

ICs can also combine analog and digital circuits on a single chip to create functions such as A/D converters and D/A converters. Such circuits offer smaller size and lower cost, but must carefully account for signal interference.

ICs come in various kinds of package. The most common is probably the dual in-line type, housing methods are the single in-line package, with pins along one edge, and the flat pack, with pins along two or four edges.

ICs are easily damaged by heat when soldered and their short pins cannot be protected with a heat sink. Instead we use a chip holder, strictly called a socket, which can be safely soldered onto the circuit board. The chip is pushed into the holder when all soldering is complete.

Future developments seem to follow the multi-core multi-microprocessor paradigm, already used by the Intel and AMD dual-core processors. Intel recently unveiled a prototype, "not for commercial sale" chip that bears 80 microprocessors. Each core is capable of handling its own task independently of the others. This design provides a new challenge to chip programming.

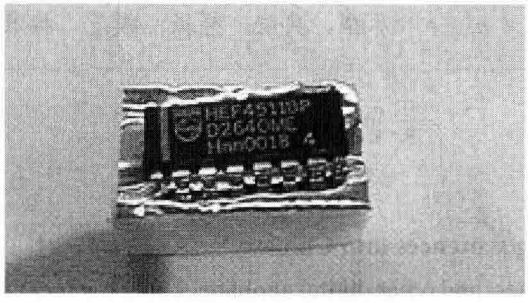


Figure 2-1 A CMOS 4000 IC in a DIP

Technical Words and Expressions

integrated	*adj.*	完整的，完全的
reduction	*n.*	缩小，减少，简化
inextricable	*adj.*	解不开的，纠缠不清的，不能解决的
chip	*n.*	碎片，薄片，碎屑
interconnect	*vt./ vi.*	（使）互相联系
substrate	*n.*	底层，地层，（半导体工艺中的）衬底，基底
definite	*adj.*	明确的，确定的，一定的
analog	*adj.*	模拟的
digital	*adj.*	数字的，数据的
synthesizer	*n.*	合成者，合成物
flip- flop	*n.*	正反器
multiplex	*adj.*	多部的，复合的，多样的，多路传输的，多路复用的
dissipation	*n.*	消散，分散，浪费，消耗，损耗