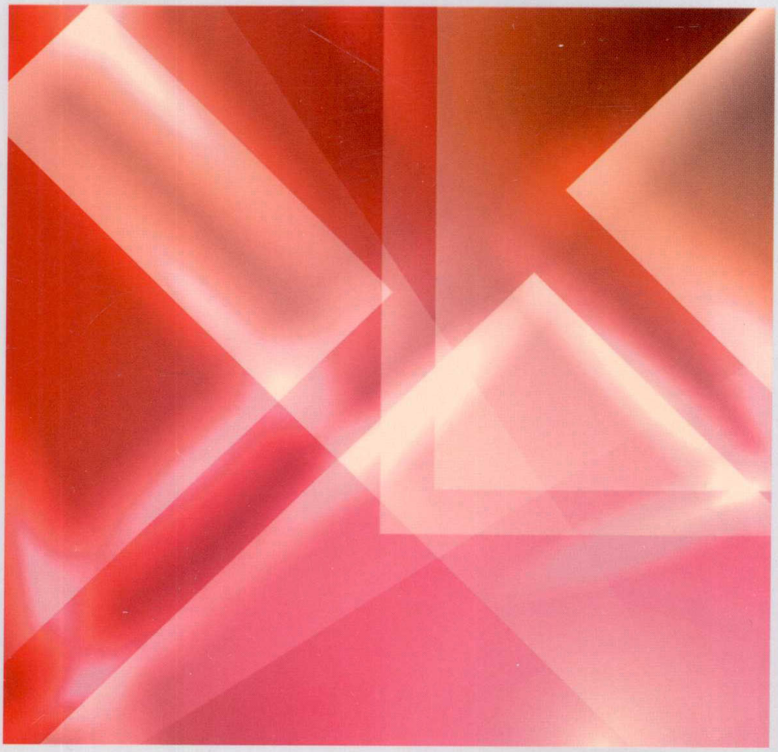
电子信息科学专业英语导读教程

（第2版）

田　岚　主编

姜晓庆　孙　蓓　陆小珊　副主编



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北　京

内 容 简 介

本书围绕电子信息科学、通信及计算机等前沿领域的相关知识，按知识结构体系组织编排，由浅入深，内容涉及电子信息类专业的电子电路、EDA 设计、信号处理与系统开发、计算机网络、多媒体技术、现代电视技术、移动通信、光纤通信等知识，还包括模式识别与人工智能、DSP 技术、嵌入式系统、生物特征识别、信息安全、GPS、3G 通信等热点内容。书中所选资料突出技术内容的正确性、完整性，并配合适当练习以考察读者对知识点的掌握。本书可使学生熟悉和掌握一定量的专业词汇和术语，了解科技英语写作和专业交流中的翻译和写作技巧，提高阅读和理解专业英语文献的能力和速度，培养英语写作和翻译技巧，开阔专业视野。

本书可作为高等院校电子信息科学、通信工程、计算机科学、自动化技术等相关专业大学本科生专业英语教材，也可作为相关领域专业人员提高英语水平的阅读参考书。本书也适合参加四、六级和研究生入学考试的学生，以便他们熟悉电子信息类学科相关文献并锻炼阅读能力。对于非电子类专业学生，这也是一本补充了解 IT 相关知识的读物。

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前　言

本书第1版自2005年2月出版以来，受到广大读者的支持和认可，被国内多所高校选用为专业英语课程的教材。截至2011年7月，本书已经7次印刷，印数超过18000册。7年来，随着电子信息技术的不断发展，新技术和新概念也不断出现，第1版中有些内容已显陈旧，因而更新和修订工作势在必行。结合教学中的意见和建议，在清华大学出版社以及山东大学相关教学改革项目的大力支持下，作者对本书进行了再版修订。

第2版遵循第1版的编写指导思想，即面向信息科学类相关专业的主流技术，兼顾电子技术、计算机、通信及自动化等相关基础理论和工程应用两方面，既覆盖合理实用的专业知识，又注重选材新颖、专业词汇丰富，力求反映信息技术发展的新特点和趋势，使读者在了解和感悟专业知识与技术发展的同时，融会贯通所学专业知识，全面了解专业涉及的领域，以引导和提高读者学习、研究及开发设计的兴趣。与第1版相比，全书正文部分仍按知识结构组织编排，单元内课文由浅入深，单元总数保持不变，仍为15个单元，但其中11个单元的内容都进行了适当的修改或添加，1、2、3单元补充了阅读材料，4、7、8、9、10、11单元更换了部分新课文及练习，6和13单元内容完全重写；最后附录部分也作了重新编写，介绍了科技论文写作和国际交流中常用的英语表达知识，力求简洁明了、学以致用。这样，新增与重写内容超过全书的1/2。教师可根据学生的接受能力，结合学时安排合理选用，同时配合灵活多样的课堂教学和课后练习，多方位地培养学生专业英语的运用能力。

通过本书知识的阅读学习，读者可熟悉和掌握大量信息技术的专业词汇和科技英语表达方式。本书可作为高等院校信息科学与工程、通信工程、计算机科学、自动化技术等相关专业大学本科生的专业英语教材，也可作为电子信息类专业导论课的教程，同时也可作为信息技术相关领域技术人员的阅读参考书。另外，本书也适合作为非电类专业的学生学习、了解IT相关知识的英语参考书。

本书再版由山东大学的田岚、陆小珊和济南大学的姜晓庆、孙蓓编写，其中第1、2、3、4、13单元由陆小珊、孙蓓编写，第6、7、8、9、10、11单元由田岚、姜晓庆编写，最后附录部分由田岚、陆小珊编写整理，全书的总体安排和审定由田岚负责。另外，本书在选材时，参考了国内外有关书籍和资料，在此，编者向这些作者致以谢意。

由于信息技术发展日新月异、新知识不断发展，加上编者水平有限，书中不足、疏漏之处在所难免，恳请读者批评指正。

编　者

2012年5月

CONTENTS

Unit 1 Microelectronics and Electronic Circuits

1-1 Introduction to Microelectronics

The exploring of space and the development of earth satellites has increased the importance of reducing the size and weight of electronic circuits. Also, even though electricity flows quite rapidly in computers the time delay of the signal in the interconnections between electronic components is an important consideration. If the interconnections are reduced in size, a computer can perform operations at a faster speed.

Microelectronics involves the miniaturization of regular electronic circuits. A complete electronic circuit, an operational amplifier for example, which contains large numbers of individual interconnected components, such as diodes resistors, transistors, etc. may be formed on a very small single substrate. The complete miniaturized circuit is then called an integrated circuit.

Integrated circuits are small, light, rugged, and reliable. They require less power and lower voltages than equivalent macroscopic circuits; consequently they operate at lower temperatures, and individual components may be close together without exceeding the operating temperature limit. Relatively little stray capacitance and short time delays are produced because of the short interconnections between the individual components in IC. Maintenance is simplified because if a component of the IC fails the complete IC is usually replaced. Mass production techniques of plane technology have reduced the cost of many IC so that they are almost as inexpensive as a single transistor. Eventually most conventional circuits will be replaced by IC.

There are two types of basic integrated circuit: monolithic integrated circuit and the thin or thick film. Monolithic IC are constructed in a single substrate of single crystal semiconductor, usually silicon. Thin or thick films IC are formed on the surface of an insulating material such as glass or a ceramic. Hybrid IC contains more than single substrate, the term hybrid is also applied to combinations of monolithic and thin or thick film IC.

Integrated circuits are also classified according to their functions. Digital or logical IC are used as switches, they are either on or off. In computers the on and off states correspond to 0 or 1. Other IC is called linear or analog IC.[1] Integrated circuits can be produced using either bipolar or unique polar transistors. FET(Field Effect Transistors) have advantages over bipolar transistors in many cases however. They are relatively high-impedance devices, with a corresponding reduction in current and power dissipation, and yet have high power gain. The reduction in power dissipation is particularly important where a complex circuit is to be concentrated into a small space. The problem of extracting the heat generated in the circuit may then be a difficult one.[2] The form of construction of the FET, and particularly the MOSFET(Metal-Oxide-Semiconductor Field-Effect-Transistor), also lends itself well to integrated circuit fabrication, and enables resistors and capacitors to be included readily in the integrated circuit.

Most electronic circuits are composed of active devices, e.g. transistors and diodes, together with resistors (for bias, collector load, impedance transformation, etc.) and capacitors (e.g. for coupling ac signals while blocking dc supplies). Each of these elements can be produced in a form suitable for integrated circuit inclusion within limitations, e.g. capacitance values must not be too large. Some elements are difficult to produce in a suitable form, e.g. inductive elements, or large capacitors. Usually some alternative circuit form can be devised that dispenses with the requirement. Otherwise they must be included as an external lumped element.

Words and Phrases

microelectronics	微电子学
amplifier	放大器
bipolar	双极的
bias	偏差；偏置
capacitor	电容
dissipation	损耗
dispense	分配
extractive	抽出；释放出
fabrication	制造，装配；捏造事实
hybrid	混合物
integrate	综合；使完全
impedance	阻抗
inductive	电感
monolithic	独立的；完全统一的
silicon	硅
substrate	基质，底质
transistor	晶体管
FET (Field Effect Transistors)	场效应管

MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) 金属氧化物半导体场效应晶体管

lumped element 集总组件

Notes

[1] Integrated circuits are also classified according to their functions. Digital or logical IC are used as switches, they are either on or off. In computers the on and off states correspond to 0 or 1. Other IC is called linear or analog IC.

也可根据其不同功能对集成电路进行分类。数字或者逻辑 IC 通常用作开关，表示接通或关断。在计算机中，接通和关断状态分别对应 0 或 1。另一种 IC 则称为线性或模拟 IC。

[2] The reduction in power dissipation is particularly important where a complex circuit is to be concentrated into a small space. The problem of extracting the heat generated in the circuit may then be a difficult one.

在将一个复杂的电子线路集成到一个较小空间时，减小功率损耗是非常重要的。要释放集成电路工作时产生的热量是一个难以解决的问题。

Exercises

1. Please choose the best answer for the question.

(1) If the interconnections are reduced in ( ), a computer can perform operations at a faster speed.

A. weight B. size C. number of components D. attenuation

(2) Which of the followings is not the characteristic of IC? ( )

A. Small. B. Light. C. Rugged. D. Unreliable.

(3) Monolithic IC is constructed in a single substrate of single crystal semiconductor, usually ( ).

A. silicon B. glass C. ceramic D. plastic

(4) ( ) can be used as switches.

A. Linear IC B. Analog IC C. Digital or logical IC D. Nonlinear IC

(5) Which of the followings is not the application of resistors? ( )

A. Bias. B. Collector load.

C. Impedance transformation. D. Coupling ac signals while blocking dc supplies.

2. True or False?

(1) Because electricity flows quite rapidly in computers the time delay of the signal in the interconnections between electronic components can be ignored.

(2) Integrated circuits require less power and lower voltages than equivalent

macroscopic circuits; consequently they operate at lower temperatures, and individual components may be close together without exceeding the operating temperature limit.

(3) Thin or thick films IC are constructed in a single substrate of single crystal semiconductor, Monolithic IC are formed on the surface of an insulating material such as glass or a ceramic.

(4) Because Digital or logical IC are either on or off, they can are used as switches.

(5) Capacitance values must not be too large in order to be suitable for integrated circuit inclusion within limitations.

1-2 How does a logic gate in a microchip work?

A gate seems like a device that must swing open and closed, yet microchips are etched onto silicon wafers that have no moving parts. So how can the gate open and close?

Larry Wissel, ASIC Applications Engineer at IBM Microelectronics, replies:

"Those of us who design logic gates for computers seldom reminisce on how the terms we use to describe technology came into use. The vision of a gate swinging back and forth clearly does not literally represent the structures on a silicon chip. But the reason for the usage of the term 'gate' for computer logic can be appreciated by examining the basic function of a gate: to control a flow."

"On a farm, gates may be used to control the 'flow' of sheep or goats between pens. In this case, the gate consists of a physical barrier whose position is controlled by a fanner. The farmer makes a decision about the flow of animals and then moves the physical barrier to permit the desired flow."

"In a computer, a gate controls the flow of electric current through a circuit. The gate consists of transistors; the transistors are selected by the chip designer from two basic types (PMOS and NMOS transistors) that are found in the ubiquitous CMOS (Complementary Metal Oxide Semiconductor) technology.[1] The current that flows through a gate establishes a voltage at a particular point in the circuit. This voltage represents a single 'bit' of information. The voltage may either be high (representing the value '1') or low (representing the value '0')."

"To establish a 1 on a circuit, the current flow is steered to the circuit (controlled) by 'turning on' a PMOS transistor connected between the circuit and the positive supply voltage. The supply voltage is usually an industry-standard value such as 3.3 or 5.0 volts. For the very brief interval that is required for a logic gate to switch (on the order of a nanosecond, or a billionth of a second), current will flow through a PMOS transistor from the positive power supply to the circuit."

"The current flow that charges the circuit node to a 0 is steered away from the circuit through a different kind of transistor (NMOS) connected between the circuit and the negative supply voltage, or electrical ground. Again, current will flow through the NMOS transistor for a very brief interval, but for the NMOS the current is between the circuit and the negative supply. In either case, the current flow results in a change in the circuit voltage that represents a bit of information. So, when a gate is controlling current flow, it is actually controlling the flow of information."

"Returning to the analogy between the farm and the computer chip, it is obvious that the flow is different (farm animals compared to information) and that the gate itself is different (a physical barrier compared to a transistor in the CMOS technology). But the most important difference is the means of controlling the flow. On the farm, the farmer resets the gate location by making a decision and then moving a physical barrier. A flow of animals through a complex maze of gates would require a farm hand at each gate."

"But in a computer chip, the control mechanism is the voltage on the control terminal of a transistor. This voltage turns on a transistor by changing its characteristics from that of an open circuit (the 'off' position) to one that can conduct a small current. This control voltage, in turn, is already available within the chip as a voltage at a point on another circuit. And, being a voltage on a circuit, this control mechanism represents a different bit of information."

"The overwhelming computing power of logic gates stems from the fact that the output of any particular gate is a voltage, which can in turn be used to control another gate.[2] A computer chip therefore can be designed to make complex decisions about the information flow within itself. This ability enables sophisticated systems to be created by interconnecting as many as a million gates within a single chip. All of this with no farm hands and no moving parts."

Tak Ning of the IBM T.J. Watson Research Center adds some complementary details:

"A logic gate in a microchip is made up of a specific arrangement of transistors. For modem microchips, the transistors are of the kind called MOSFET, and the semiconductor used is silicon. A MOSFET has three components or regions: a source region, a drain region and a channel region having a gate over it. The three regions are arranged horizontally adjacent to one another, with the channel region in the middle."

"In a logic gate arrangement, each of the MOSFET works like a switch. The switch is closed, or the MOSFET is turned on, if electric current can flow readily from the source to the drain. The switch is open, or the MOSFET is turned off, if electric current cannot flow from the source to the drain."[3]

"The source and drain regions of a MOSFET are fabricated to be full of electrons which are ready to carry current. The channel region, on the other hand, is designed to be empty of electrons under normal condition, blocking the movement of current. Hence, under normal condition, the MOSFET is 'off' (or 'open') and no current can flow from the source to the drain."

"If a positive voltage is applied to the gate (which sits on top of the channel region), then electrons, which are negative charges, will be attracted toward the gate. These electrons are collected in the channel region of the MOSFET. The larger the gate voltage, the larger is the concentration of electrons in the channel region. The substantial concentration of electrons in the channel provides a path by which the electrons can move easily from the source to the drain. When that happens, the MOSFET is 'on' (or 'closed') and current can flow from the source to the drain freely."

"In summary, a MOSFET in a microchip is turned on by applying a voltage to the gate to attract electrons to the channel region, and turned off by applying a voltage to the gate to repel electrons away from the channel region. There is movement of charges in the silicon, but there are no mechanical moving parts involved."[4]

What's a MOSFET?

MOSFET is a kind of transistor that clips gradually when overdriven, as most tubes do.

Both tubes and transistors amplify signals by passing current from one side of the device to the other, sculpting it along the way to the same shape as a much weaker input signal. It's like a movie or slide projector — a source of energy (the bulb) is shaped by the film, and projected on the screen, where we see a much bigger version of the image on the film (even though the actual light we see comes from the bulb, not the film).

There are basically three kinds of transistor that are used to amplify audio: the most common is a bipolar transistor. It is a sandwich of three layers of silicon, with the outer ones negatively charged and the middle one positively charged (NPN), on the other way around (PNP). A small signal on the middle layer controls a much bigger current passing between the two outer layers.

A later development was the FET. Here the current doesn't have to pass through the middle layer of the sandwich. It passes near it, and is controlled by the field effect exerted on it. This was more efficient in a number of ways. It also happens to clip more softly than a bi-polar transistor.

The third type is an FET where the element doing the controlling doesn't even contact the channel carrying the large current. It's insulated with a thin layer of silicon dioxide - a kind of glass. This is the MOSFET, and it clips very softly.

The clipping characteristics of individual vacuum tube or solid-state semiconductors are by no means the whole story in the behavior of a circuit. You've probably noticed by now that a circuit with a tube in it can produce a sound that's buzzer and harsher than another that's made up of bi-polar transistors. And the sound that formed the original criterion for what is desirable in overdrive, the sound of a cranked non-master-volume tube amp, has got to do with a lot things besides the tubes. There are transformers, speakers and the interaction of these with the tubes, to say nothing of the acoustic and psycho-acoustic byproducts of playing loud. Anyone interested in getting a repeatable sound that isn't dependant on playing at a certain sound pressure level would better off discarding the dogma surrounding tubes and transistors, and employing the only devices that can be trusted—the ears.

Words and Phrases

reminisce	缅怀往事，话旧
steer	掌舵，操纵，驾驶
ubiquitous	无处不在的
wafers	晶片，圆片
Involved	繁杂的，受牵扯的
COMS (Complementary Metal Oxide Semiconductor)	互补金属氧化物半导体

Notes

[1] The gate consists of transistors; the transistors are selected by the chip designer from two basic types (PMOS and NMOS transistors) that are found in the ubiquitous CMOS (Complementary Metal Oxide Semiconductor) technology.

门电路由晶体管组成，而这些晶体管是由芯片的设计者从广泛使用的 CMOS（互补金属氧化物半导体）技术中出现的两种基本类型的晶体管（PMOS 晶体管和 NMOS 晶体管）选择确定的。

[2] The overwhelming computing power of logic gates stems from the fact that the output of any particular gate is a voltage, which can in turn be used to control another gate.

逻辑门电路的强大计算能力源于这样一个事实：任何特殊门电路的输出都是一个电压信号，这个电压又可以用来控制另外的门电路。

[3] In a logic gate arrangement, each of the MOSFET works like a switch. The switch is closed, or the MOSFET is turned on, if electric current can flow readily from the source to the drain. The switch is open, or the MOSFET is turned off, if electric current cannot flow from the source to the drain.

在逻辑门电路的排列中，每一个场效应晶体管就像一个开关一样工作。如果电流可以容易地从源极流向漏极，则开关处于闭合状态，或场效应晶体管处于开启状态。如果电流不能从源极流向漏极，则开关处于断开状态，或场效应晶体管处于关闭状态。

[4] In summary, a MOSFET in a microchip is turned on by applying a voltage to the gate to attract electrons to the channel region, and turned off by applying a voltage to the gate to repel electrons away from the channel region. There is movement of charges in the silicon, but there are no mechanical moving parts involved.

总之，微芯片上的一个场效应晶体管通过给漏极加载电压把电荷吸引到沟道区域，从而使场效应晶体管处于开启状态；如果给栅极加载一个电压来阻止电荷，使之远离为道区

域，则场效应晶体管处于关闭状态。硅片中有存在电荷的运动，但并没有涉及任何可移动的机械部件。

Exercises

1. According to Prof. Larry Wissel's replies, answer the following questions.

(1) In the 3rd paragraph, "a single 'bit' of information" means (   ).

A. a voltage at a particular point in the circuit

B. two basic types (PMOS and NMOS) of transistors

C. one kind of the two basic types (PMOS and NMOS) of transistors

D. high (representing the value '1') or low (representing the value '0') voltage which can be used as a signal in a computer

(2) According to the passage, the control mechanism in a computer chip is (   ).

A. the voltage on the control terminal of a transistor

B. the decision to move the physical barrier

C. the voltage at a particular point in the circuit

D. the means of controlling the flow

(3) Studying of the analogy between the farm and the computer chip, it is obvious that (   ).

A. the flow is different
B. the gate itself is different

C. the means of controlling the flow is different
D. all of above

(4) The overwhelming computing power of logic gates stems from the fact that the output of any particular gate is (   ).

A. a voltage which can in turn be used to control another gate

B. an open circuit that can conduct a small current

C. a transistor in the CMOS technology

D. an industry-standard value such as 3.3 or 5.0 volts

(5) A computer, can make complex decision because (   ).

A. any gate can in turn be used to control another gate

B. a transistor in the CMOS technology consumes less power

C. a PMOS transistor connects to power supply

D. a NMOS transistor connects to negative supply voltage

2. According to Prof. Tak Ning's complementary details, answer the following questions.

(1) A MOSFET has three components, or regions: (   ).

A. a source region, a drain region and a channel region having three gates over it

B. a source region, a drain region and a channel region having a gate over it

C. a transmit region, a drain region and a base region having a gate over it

D. a source region, a transmit region and a channel region having three gates over it

(2) The three regions are arranged horizontally adjacent to one another, with ( ) in the middle.

A. the transmit region B. the source region

C. the channel region D. the drain region

(3) ( ) is designed to be empty of electrons under normal condition, blocking the movement of current.

A. The transmit region B. The source region

C. The channel region D. The drain region

(4) Under normal condition, the MOSFET is ( ) from the source to the drain.

A. "off" (or "close") and the current can flow

B. "off" (or "open") and no current can flow

C. "on" (or "open") and the current can flow

D. "on" (or "close") and no current can flow

(5) The substantial concentration of electrons in the channel provides a path by which the electrons can move easily from ( ).

A. the source to the drain B. the channel to the drain

C. the source to the channel D. the channel to the other side of the channel

3. According to passage "What's a MOSFET?", answer the following questions.

(1) MOSFET is a kind of ( ).

A. tube B. PNP

C. transistor D. NPN

(2) There are basically three kinds of transistor-that are used to amplify audio: the most common is ( ).

A. a bipolar transistor B. a PNP type transistor

C. a NPN type transistor D. a tripolar transistor

(3) To amplify signal by a MOSFET means ( ).

A. a big signal on the middle layer controls a much smaller current passing between the two outer layers

B. a small signal on the middle layer controls a much bigger current passing between the two outer layers

C. a small signal between the two outer layers controls a much bigger current passing the middle layer

D. a big signal between the two outer layers controls a much smaller current passing the middle layer

(4) A later development was the FET, here the current ( ).