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导读教程

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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，按知识结构划分为15个单元，涉及电子电路、EDA设计、微处理器设计、计算机网络、多媒体技术、移动通信、现代电视技术、光纤通信、信号处理、信息安全、模式识别与人工智能等电子信息学科的专业知识，内容广泛，选材新颖。每个单元包括多篇课文，以增强学生阅读兴趣和扩展其知识面，课后给出部分词汇和关键短语释义以及较难懂句子注释，并配有一定量的练习题，以考查学生阅读理解能力和知识点的掌握。本书可使学生熟悉和掌握一定量的专业英语词汇和术语，了解科技文献的表达特点，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的专业英语和专业导论教材，也可用作相关领域专业人员提高英语水平的阅读参考书。本书同样适合参加四、六级和研究生入学考试的学生熟悉电子信息类学科相关文献和锻炼阅读能力，对非电子类专业本科生，也是一本新颖的了解IT相关知识的读物。

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前　　言

本书结合电子信息技术发展的特点，力求反映信息科学相关专业最新技术发展和主流技术，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，全面了解专业涉及技术，以引导和提高读者学习、研究及开发设计的兴趣。

本书选材新颖、内容丰富，选材立足专业性、实用性，兼顾发展热点和本专业主流技术，课文内容取自英语原文杂志、网上或书刊中的文章和章节，经编写而成，涉及到电子信息类专业的电子电路、EDA设计、微处理器设计、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、信号与信息处理、生物特征识别、信息安全、GPS、3G通信、神经网络等发展热点问题。所选资料突出技术内容的正确性、完整性，兼顾读者的接受能力，按知识结构体系组织编排，由浅入深。全书共分为15个单元，每个单元均由内容关联密切的多篇课文组成，每课包括课文、词汇与短语释义、长句难句注释，并在文章后面配有一定量的练习题，以帮助读者掌握学习要点和自查阅读效果。本书在近两年的本科教学实践中得到检验，并获得较好效果。

书中覆盖了大量的电子、计算机、通信及电气自动化等方面的专业词汇和术语。通过学习，读者可熟悉和掌握相关领域科技英语句法结构特点和常用表达方式。另外，在附录中还介绍了一些科技论文写作和学术交流中常用的英语表达知识，力求学以致用。这样，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。

本书由山东大学信息科学与工程学院田岚主编，其中第1、2、3、5、7、9、12、13、14单元由田岚和田旭编写，第6、10、11单元由陆小珊编写，其余单元和附录部分由山东建工学院郝红尉、济南大学王少力、山东轻工业学院张少蔚、山东理工大学尹丽菊参加编写。田岚对全书作了统稿和核对。参加本书编写的还有姜晓庆、陈文钢、崔国辉、张国伟和韩民等，在此表示衷心感谢。

本书承蒙清华大学出版社的大力支持，感谢清华大学郑福裕教授对本书的认真审阅和指导，感谢曾刚编辑对本书出版过程给予的热情关怀和帮助，感谢兄弟院校有关领导的支持和协助。

信息技术发展迅猛，专业英语教学研究活动日益深入。本书仅仅是编者近年来教学方面的一点总结。由于时间仓促，加之作者水平有限，书中不足之处在所难免，恳请读者不吝指正。

本书的出版得到山东大学教材建设出版基金的资助。

编　者

2005年1月

CONTENTS

UNIT 1 Microelectronics and Electronic Circuits

1-1 Introduction to Microelectronics

The exploring of space and the development of earth satellites have 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(IC).

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 the 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 ICs so that they are almost as inexpensive as a single transistor. Eventually most conventional circuits will be replaced by the IC.

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

Integrated circuits are also classified according to their functions. Digital or logical ICs 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. Field effect transistors (FET) have an 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, 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.

KEY WORDS

microelectronics ['maikrəui'lek'trɔniks]	*n.* 微电子学
amplifier ['æmpli,faiə]	*n.* 放大器
bipolar（电子）[bai'pəulə]	*a.* 双极的
bias ['baiəs]	*n.* 偏差；偏置
capacitor [kə'pæsitə]	*n.* 电容器
dissipation [,disi'peiʃən]	*n.* 损耗
dispense [dis'pens]	*v.* 配给，免除
extract [iks,trækt]	*v.* 抽出；释放出
fabrication [,fæbri'keiʃən]	*n.* 制造，装配
FET（field effect transistors）	*n.* 场效应晶体管
hybrid ['haibrid]	*a.* 混合的
integrate['intigreit]	*v.* 综合；使完全
impedance [im'pi:dəns]	*n.* 阻抗
inductive [in'dʌktiv]	*a.* 电感的，感应的
lumped element	集总元件
monolithic[,mɔnə'liθik]	*a.* 独立的；完全统一的
silicon ['silikən]	*n.* 硅
substrate ['sʌbstreit]	*n.* 基片，衬底
transistor [træn'zistə]	*n.* 晶体管

NOTES

[1] Integrated circuits are also classified according to their functions. Digital or logical ICs

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.

也可根据其功能不同对集成电路进行分类。数字 IC（也称为逻辑 IC）通常用作开关，表示接通或关闭。在计算中，接通和关闭状态分别对应 0 或 1。另一种 IC 被称为线性或模拟 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.

对于一个复杂的电子线路集成为一小块的情况，减小功率损耗是非常重要的，要释放这种电路产生的热量将是一个难题。

EXERCISES

True/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 film ICs are constructed in a single substrate of single crystal semiconductor. Monolithic ICs are formed on the surface of an insulating material such as glass or a ceramic. (   )

(4) Because digital or logical ICs are either on or off, they can be 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 modern microchips, the transistors are of the kind called metal-oxide-semiconductor field-effect transistor (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 MOSFETs 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 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 stands for metal-oxide-semiconductor field-effect transistor. It's 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 field-effect transistor (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 bipolar 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. 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 buzzier and harsher than another that's made up of bipolar transistors. And the sound that formed the original criterion for what's 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 biproducts of playing loud. Anyone interested in getting a repeatable sound that isn't dependant on playing at a certain sound pressure level would be better off discarding the dogma surrounding tubes and transistors, and employing the only devices that can be trusted—the ears.

KEY WORDS

CMOS (complementary metal-oxide semiconductor) 互补金属氧化物半导体

involved [in'vɔlvd] *a.* 繁杂的，受牵扯的

MOSFET (metal-oxide-semiconductor field-effect transistor) 金属氧化物半导体场效应晶体管

reminisce [ˌremiˈnis] *v.* 缅怀往事，话旧
steer [stiə] *v.* 掌舵，操纵，驾驶
ubiquitous [juːˈbikwitəs] *a.* 无处不在的
wafer [ˈweifə] *n.* 晶片，圆片

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设计者从广泛应用的 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）中选择的。

[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，即任何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 MOSFETs 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，每一个金属氧化物半导体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，通过给漏极加上电压把电荷吸引到沟道区域，可使微芯片中的金属氧化物半导体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，使之远离沟道区域，则场效应晶体管处于关闭状态。硅片中有电荷的运动，但并不涉及任何移动的机械部件。

EXERCISES

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

(1) In the third 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 the 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 decisions 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. an 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 stands for metal-oxide-semiconductor field-effect transistor, it's a kind of ______.

A. tube B. PNP

C. transistor D. NPN

(2) There are basically three kinds of transistors that are used to amplify audio: the most common is______.

A. a bipolar transistor B. a PNP type transistor

C. an NPN type transistor D. a tripolar transistor

(3) To amplify a 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 field-effect transistor (FET), here the current _____.

A. doesn't have to pass through the middle layer of the sandwich

B. passes near it

C. is controlled by the field effect exerted on it

D. all of the above

(5) "The clipping characteristics of individual vacuum tube or solid-state semiconductors are by no means the whole story in the behavior of a circuit." The writer means _____.

A. clipping characteristics of individual vacuum tube are the same as work in a circuit

B. clipping characteristics of solid-state semiconductors are better than the behavior of a circuit

C. clipping characteristics of individual vacuum tube are worse man the behavior of a circuit

D. none of the above