高职高专“十一五”电子信息类专业规划教材

电子信息类专业英语

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机械工业出版社
CHINA MACHINE PRESS

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本教材为高职高专"十一五"电子信息类专业规划教材之一。编写内容按教育部高职高专电子信息类专业所涉及的专业课程分为电子技术基础及应用、仪器仪表与测量方法、家用电器、传感器及应用、数字信号与转换、微电子学与平面工艺、封装技术及电子设计自动化软件等内容。全书共12个单元，每个单元3篇课文，前2篇为精读课文，第3篇作为阅读材料。每篇精读课文后都提供了课后练习题，具有一定的针对性，有利于检验学生掌握课文的程度。教材在选材上独具匠心，力求不仅能体现专业性，还能体现趣味性；点面结合，每个单元不仅突出一个领域的技术与应用，同时还注重各专业、学科间知识的相关性；贴近实际，不仅收录了大量专业实用词汇，还选取了大量的新知识和新的应用实例。

本教材旨在扩大学生的专业词汇量，提高学生英文专业文章的阅读能力，同时使学生获得更多的电子信息类专业方面的新知识并了解新的发展动态。

本书可作为高等职业教育电子信息类专业的英语教材，也可供相应水平的读者与技术人员参考使用。

图书在版编目（CIP）数据

电子信息类专业英语/温丹丽主编．—北京：机械工业出版社，2009.2
高职高专"十一五"电子信息类专业规划教材
ISBN 978-7-111-25689-2

Ⅰ．电… Ⅱ．温… Ⅲ．①电子技术—英语—高等学校：技术学校—教材②信息技术—英语—高等学校：技术学校—教材 Ⅳ．H31

中国版本图书馆CIP数据核字（2009）第014419号

机械工业出版社（北京市百万庄大街22号 邮政编码100037）
策划编辑：于 宁 责任编辑：曲世海
版式设计：霍永明 责任校对：纪 敬
封面设计：王伟光 责任印制：洪汉军
北京瑞德印刷有限公司印刷（三河市胜利装订厂装订）
2009年3月第1版第1次印刷
184mm×260mm・10.25印张・243千字
0001-4000册
标准书号：ISBN 978-7-111-25689-2
定价：17.00元

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前　言

《电子信息类专业英语》是高职高专“十一五”电子信息类专业规划教材之一。

通过学习专业英语，可以扩大学生的专业词汇量，提高学生英文专业文章的阅读能力，同时使学生获得更多的电子信息类专业方面的新知识和新的发展动态。

本教材具有如下特点：

1）教材内容安排上，按电子信息类专业所涉及的专业课程分成电子技术基础及应用、仪器仪表与测量方法、家用电器、传感器及应用、数字信号与转换、微电子学与平面工艺、封装技术及电子设计自动化软件等内容。全书共12单元，每个单元3篇课文，前两篇为精读课文，第3篇作为阅读材料。每个单元突出一个领域的技术与应用，是电子信息类的通用专业英语教材。

2）选材新颖，点面结合，注重各专业、学科间知识的相关性。选材不仅能体现专业性还能体现趣味性，同时选取了大量的新知识和新的应用实例。

3）每篇精读课文后都提供了课后练习题，具有一定的针对性，有利于检验学生掌握课文的程度，便于教师更好地进行教学活动；每个单元中的阅读材料，可作为学生自学内容。学生通过阅读，可以了解更多的专业知识。

4）为了便于扩大学生的专业词汇量，书中更注重专业词汇的介绍。本书还介绍了专业英语语言的结构特点、专业英语的翻译技巧和专业构词法，对学生掌握和理解专业词汇会有很大的帮助。另外也介绍了一些常用的数字、数学表达式与英语读法等。

本教材由沈阳师范大学职业技术学院温丹丽担任主编，大连职业技术学院邹显圣和沈阳建筑大学外国语学院程娟担任副主编，沈阳药科大学高等职业技术学院孙清、辽宁装备制造职业技术学院张君薇和沈阳师范大学职业技术学院林淑芝参与编写。具体分工如下：温丹丽编写了第6单元、第9至12单元、第7单元和第8单元的阅读材料部分；邹显圣编写了第1至3单元；程娟编写了专业英语语言的结构特点，专业英语翻译技巧，构词法，数字、数学表达式与英文读法等部分；孙清编写了第4单元和第5单元；张君薇编写了第7单元和第8单元的精读课文部分；林淑芝编写了希腊字母及其读法、常用电子信息类专业英语词汇、常用电子信息类专业英语词汇缩写和电子信息类相关专业课程名称。全书由东北大学外国语学院韩忠军担任主审，在此表示衷心的感谢。

限于编者水平有限，书中难免有不足、疏漏之处，敬请广大读者批评指正。

编　者

目　　录

Unit One The Basis of Electronic Technology

Passage One Diode and Transistor

1. What is forward bias?
2. What are the electrical properties of junction or diode?
3. What are the arrangements of two-junction transistor?

Text

1. PN Junction (**Diode**)

When a free **electron** meets a moving hole in a **semiconductor** material, the electron occupies the free space and a **positive** or **negative** charge no longer exists, that is, the charge is **neutralized**. When a P-type and a N-type crystal are joined to make a single semiconductor, as shown in Fig. 1-1, current will flow in one direction only. As an example, when a power source is connected to the semiconductor as shown in Fig. 1-2, the semiconductor is said to be forward biased.

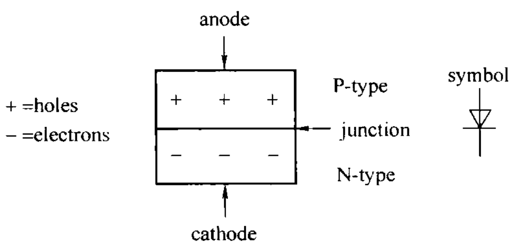

Fig. 1-1 The basic crystal junction

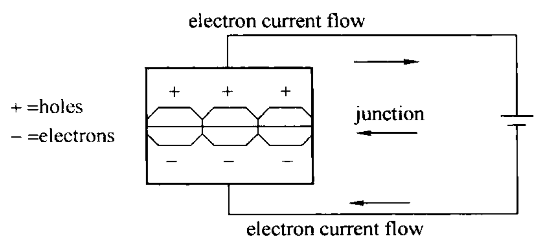

Fig. 1-2 Forward biased connection in

The holes will be repelled toward the **junction** by the positively charged battery **terminal**, whereas the electrons are pushed toward the junction by the battery's negative terminal.

At the junction, the electrons **combine** with the holes. Electrons enter the semiconductor at the N terminal to replace the electrons that have combined with the holes. Likewise, electrons leave the P terminal by attraction of positive voltage, which creates new holes. This movement of electrons, from the negative voltage source through the junction and from the positive terminal of semiconductor to positive voltage source, creates a current flow. Thus current will flow in a semiconductor when the semiconductor is forward biased.

When the **polarity** of the power source is reversed, the semiconductor is said to be reverse biased. The holes are moved away from the junction by the negative voltage, whereas the electrons are drawn the junction by the positive voltage. Thus there is little or no combining of electrons and holes at the junction, and no current will flow.

In practical terms, there will always be a few electrons and holes near the junction, allowing a very small current to pass. This small current is known as **leakage current** and is usually in the order of a few **microamperes** (or possibly picoamperes).

When P-type and N-type regions are formed in same crystal, the semiconductor is known as a diode or **rectifier**. The **boundary** between the two regions is termed a junction. The P-region terminal is called the **anode**, whereas the N-region terminal is called the cathode.

Usually, when such semiconductors are used with signals, the semiconductors are called diodes or signal diodes. When the device is used for conversion of alternating current (AC) to direct current (DC) , the semiconductor is called a rectifier.

2. Basic Two-junction or Bipolar Transistor

Like a diode, a transistor can be used to prevent (or limit) the flow of current in one direction. The prime use for a transistor, however, is to control the amount of current in a circuit. This is done by adding a second junction to the basic diode junction, discussed in the above section. For this reason, such transistors are called two-junction transistors or **bipolar transistors**. The author prefers the former term but recognizes that the latter term is also in common use.

There are two possible arrangements for the two-junction in transistors: NPN, where a positive semiconductor material (holes) is placed between two negative semiconductor materials (electrons), and PNP, where the negative material (electrons) is placed between two positive materials (holes).

With either junction arrangement, the basic two-junction transistor will have three elements. These elements, shown in Fig. 1-3 as an NPN arrangement are the **emitter**, which emits electrons;the collector, which collects electrons; and the base, which controls the flow of electrons by controlling the charge concentration at the two-junction on either side of the base.

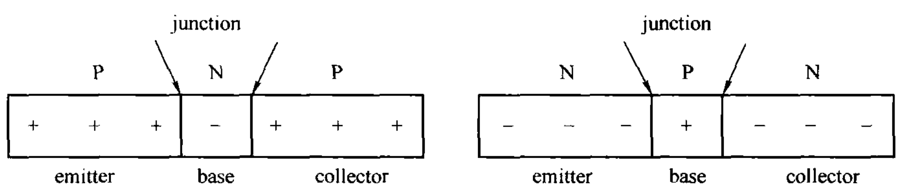

Fig. 1-3 NPN and PNP two-junction transistor arrangements

Fig. 1-4 shows how two-junction transistor operates in its basic circuit. As shown, the emitter-base junction will pass current easily because the junction is forward biased. The collector-base junction will not pass current (except for a small leakage current) since the junction is reverse biased (The term back is often used in place of reverse bias).

It should be noted that the polarities of bias voltage for an NPN transistor differ from

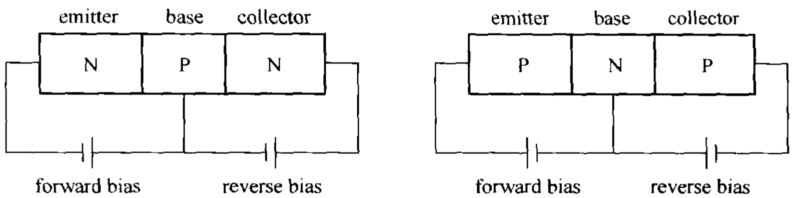

Fig. 1-4 Basic two-junction transistor bias circuit

those of a PNP transistor; however, the net results are the same. For example, as shown in Fig. 1-4, the emitter is negative with respect to the base (NPN) to produce a forward bias. In Fig. 1-4, the emitter is positive with respect to base (PNP) to produce the same forward bias. Similarly, the collector has a reverse bias for both NPN and PNP, even though the polarities are revered. Also, it should be noted that for normal operation an NPN has its base biased positively with respect to its emitter. Conversely, a PNP base is negative with respect to its emitter.

Words and Expressions

diode [ˈdaiəud] *n.*	二极管
electron [iˈlektrɔn] *n.*	电子
semiconductor [ˈsemikənˈdʌktə] *n.*	[物] 半导体
positive [ˈpɔzətiv] *a.*	[电] 正的，阳性的
negative [ˈnegətiv] *a.*	[电] 负的，阴性的
neutralize [ˈnjuːtrəlaiz] *v.*	使中和
junction [ˈdʒʌŋkʃən] *n.*	连接，汇合处，结
terminal [ˈtəːminl] *n.*	接线端，电极
combine [kəmˈbain] *v.*	（使）联合，（使）结合
polarity [pəuˈlæriti] *n.*	极性
microampere [ˈmaikrəuˈæmpɛə] *n.*	[电] 微安 [培]
rectifier [ˈrektifaiə] *n.*	整流器（管）
boundary [ˈbaundəri] *n.*	边界，分界线
anode [ˈænəud] *n.*	[电] 阳极，正极
emitter [iˈmitə] *n.*	发射极
leakage current	漏电流
bipolar transistor	双极晶体管

Exercises

Ⅰ. Match the items listed in the following two columns.

1. positive charge　　　　a. 与……结合

2. negative charge b. 正向偏置
3. forward bias c. 正电荷
4. reverse bias d. 反向偏置
5. combine with e. 负电荷

Ⅱ. Complete the following sentences according to the text.

1. The holes will be repelled toward the junction by the ____ charged battery terminal.
2. At the junction, the ________ combine with the holes.
3. There are two possible arrangements for the two-junction in transistors: ____ and ____.
4. During normal operation of a two-junction transistor, current will flow between the emitter and base and between the emitter and collector, but not between ________ and ________.
5. In a PNP transistor, the ________ bias between the emitter and base causes holes to flow into the base.

参考译文

二极管和晶体管

1. PN 结（二极管）

在半导体材料中，当一个自由电子与一个运动的空穴相遇时，电子占据了空穴，此时，正的或负的电荷已经不再存在了，也就是说，电荷被中和掉了。如图 1-1 所示，当一个 P 型和一个 N 型晶体被连接在一起形成一个简单的半导体时，电流只能单方向流动。例如，当一个电源被连接到图 1-2 所示的半导体两端时，半导体正向偏置。

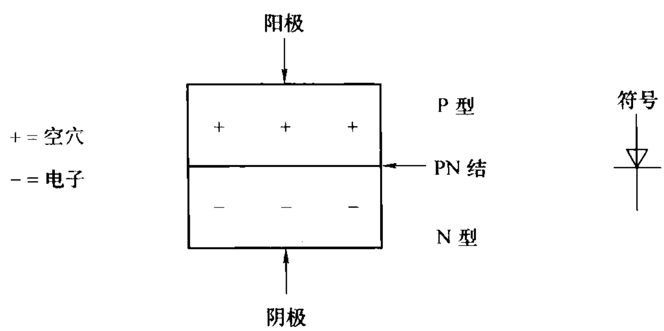

图 1-1 基本的晶体结

空穴在电源正极的作用下被驱赶到 PN 结，相反，在电源负极的作用下，电子将被推向 PN 结。

在 PN 结处，电子与空穴结合。在 N 端，电子进入半导体，代替已经与空穴相结合的电子。同样地，电子在正极电压的吸引下，离开 P 端并产生了新的空穴。电子从电源负极穿过 PN 结的运动以及从半导体的正端向电源正极的运动，产生了电流。这样，当半导

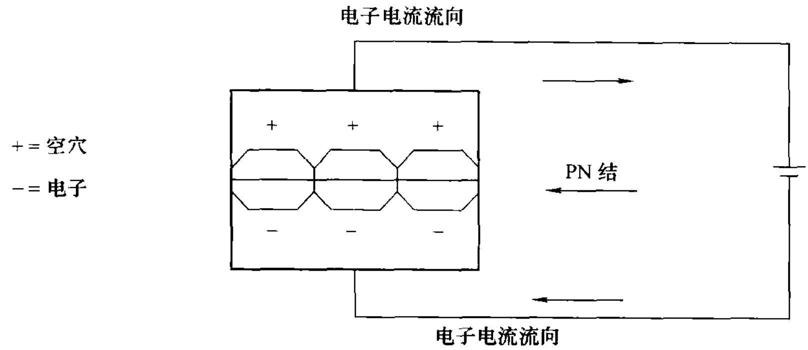

图 1-2 正向偏置连接

体正向偏置时，电流将在半导体中流动。

当电源极性被颠倒过来时，半导体反向偏置。空穴在负电压的作用下，离开 PN 结，相反，电子在正向电压的作用下，向 PN 结处运动。这样一来，仅有很小一部分或几乎没有电子与空穴在 PN 结处结合，也就没有电流流动。

实际上，在 PN 结附近，总有少量的电子和空穴，允许极小的电流流过。这个极小的电流被称为漏电流，一般大约只有几个微安（或者可能是皮安）。

当 P 型区域和 N 型区域在同一个晶体内形成时，这个半导体被称为二极管或整流管。这两个区域之间的边界称为一个 PN 结。P 型区域的引线端称为阳极，而 N 型区域的引线端称为阴极。

通常，当这样的半导体用于信号方面时，该半导体被称为二极管或信号二极管。当该器件用于交流电向直流电的变换时，该半导体则被称为整流管。

2. 基本的两结或双极晶体管

像二极管一样，晶体管能阻止或限制电流在一个方向上的流动。然而，晶体管的主要用途是控制电流在电路中的大小。它之所以能够这样工作，是因为在基本的二极管 PN 结的基础上添加了另一个 PN 结，有关 PN 结的内容在上一部分中已经讨论过了。正是因为这个原因，这样的晶体管被称为两结晶体管或双极晶体管。作者偏向于前一种术语，但承认后者也被普遍使用。

晶体管中的两个结有两种可能的排列方式：NPN 型，在两个 N 型半导体材料（电子）中间放置一个 P 型半导体材料（空穴）；PNP 型，在两个 P 型半导体材料（空穴）中间放置一个 N 型半导体材料（电子）。

对任何一种 PN 结的排列方式，基本的两结晶体管都有三个电极。图 1-3 所示的 NPN 型晶体管中，这些电极分别是：发射电子的发射极；收集电子的集电极；基极，它通过控制基极两侧任一 PN 结中电荷的浓度来控制电子的流动。

图 1-4 展示了两结晶体管在它们的基本电路中是如何工作的。如图 1-4 所示，对于发射极-基极结，因为是正向偏置，所以电流能够很容易地通过。对于集电极-基极结，因为是反向偏置（后一个术语反向偏置“reverse biased”通常用“reverse bias”代替），所以电流不能够通过（小部分的漏电流除外）。

应该注意到的是，对于一个 NPN 型晶体管，其偏置电压的极性与 PNP 型晶体管的不

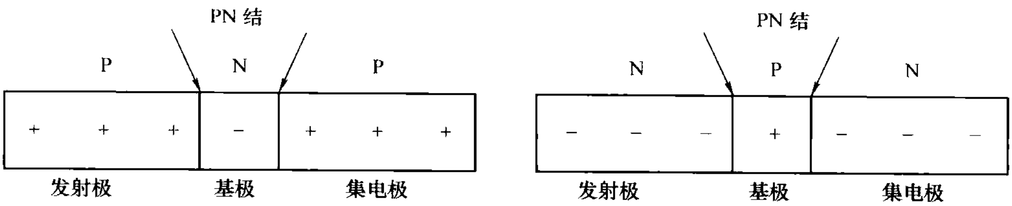

图 1-3 NPN 和 PNP 两结晶体管

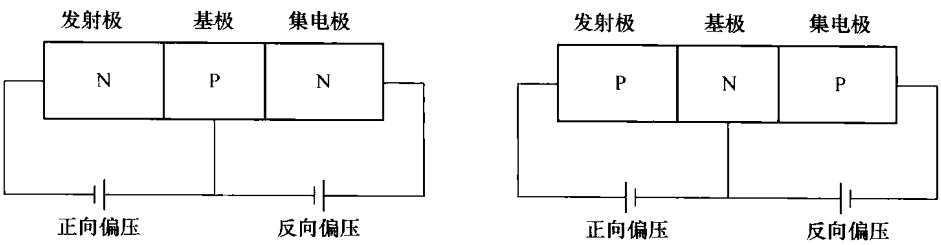

图 1-4 基本的两结晶体管偏置电路

同，但是，最终的结论却是相同的。例如，如图 1-4 所示，相对于 NPN 型管基极来说，发射极是负的，产生正向偏置。在图 1-4 中，相对于 PNP 型管基极来说，发射极是正的，同样也产生正向偏置。同样地，即使极性反向，NPN 型管和 PNP 型管的集电极都有一个反向偏置。同样，也应该注意到在正常工作的情况下，NPN 型管的基极相对于发射极，正向偏置。相反，PNP 型管的基极相对于发射极是反向偏置的。

Passage Two Kirchhoff's Law and Linear Circuit Analysis

1. What is Kirchhoff's current law?
2. What is a node?
3. What is Kirchhoff's voltage law?

Text

1. Kirchhoff's Current Law (KCL)

It is a **consequence** of the work of the German Physicist Gustav Kirchhoff(1824 ~ 1887) that enables us to analyze an interconnection of any number of elements (voltage sources, current sources, and resistors), as well as other electronic devices. We will refer to any such interconnection as a circuit or a **network**.

For a given circuit, a connection of two or more elements shall be called a **node**. We now present the first of Kerchief's two laws, his current law (KCL), which is essentially the law of **conservation** of electric charge:

At any node of a circuit, at every instant of time, the sum of the currents into the node is equal to the sum of the currents out of the node.

$$\sum i_{in} = \sum i_{out}$$

An alternative, but equivalent, form of KCL can be obtained by considering currents directed into a node to be positive in sense and currents directed out of a node to be negative in sense. Under this **circumstance**, the alternative form of KCL can be stated as follows:

At any node of a circuit, the currents **algebraically** sum to zero.

$$\sum i = 0$$

2. Kirchhoff's Voltage Law (KVL)

We now present the second of Kirchhoff's laws, the voltage law. To do this, we must introduce the concept of a "**loop**". Starting at any node n in a circuit, we form a loop by **traversing** through elements and returning to the starting node n, and never **encountering** any other node more than once. Kirchhoff's voltage law (KVL) is:

In traversing any loop in any circuit, at every instant of time, the sum of the voltages having one polarity equals the sum of the voltages having the opposite polarity.

$$\sum u_+ = \sum u_-$$

An alternative statement of KVL can be obtained by considering voltages across elements that are traversed from plus to minus to be positive in sense and voltages across elements that are traversed from minus to plus to be negative in sense (or vice versa). Under this circumstance, KVL has the following alternative form:

Around any loop in a circuit, the voltages algebraically sum to zero.

$$\sum u = 0$$

3. **Sinusoidal** Circuits

Step and **impulse** functions are useful in determining the responses of circuits when they are first turned on or when sudden or **irregular** changes occur in the input. This is called **transient** analysis. However, to see how a circuit responds to a regular or repetitive input—the steady-state analysis-function that is by far the most useful is the sinusoid.

The sinusoid is an extremely important and **ubiquitous** function. To begin with the shape of ordinary household voltage is sinusoidal, consumer radio transmissions are either **amplitude modulation** (AM), in which the amplitude of a sinusoid is changed or modulated according some information signal, or **frequency modulation** (**FM**), in which the frequency of a sinusoid is modulated.

We have following conclusions about the sinusoid:

1) If the input of a linear, time-invariant circuit is a sinusoid, then the response is sinusoid of the same frequency.

2) Finding the **magnitude** and **phase angle** of a sinusoidal steady-state response can be accomplished with either real or complex sinusoids.

3) If the output of a sinusoidal circuit reaches its peak before the input, the circuit is a **lead network**. Conversely, it is a **lag network**.

4) Using the concepts of **phasor** and **impedance**, sinusoidal circuits can be analyzed in the frequency domain in a manner analogous to resistive circuits by using the phasor versions of KCL, KVL, nodal analysis, mesh analysis and loop analysis.

Words and Expressions

consequence [ˈkɔnsikwəns] *n.*	结果，推论
network [ˈnetwəːk] *n.*	网络
node [nəud] *n.*	节点
conservation [ˌkɔnsə(ː)ˈveiʃən] *n.*	守恒
circumstance [ˈsəːkəmstəns] *n.*	境况，情况
algebraical [ˌældʒiˈbreiikəl] *a.*	代数的
loop [luːp] *n.*	回路
traverse [ˈtrævə(ː)s] *v.*	穿越，通过
encounter [inˈkauntə] *v.*	遇到，相遇
impulse [ˈimpʌls] *n.*	脉冲
irregular [iˈregjulə] *a.*	不规则的，无规律的
transient [ˈtrænziənt] *a.*	短暂的
ubiquitous [juːˈbikwitəs] *a.*	普遍存在的
magnitude [ˈmægnitjuːd] *n.*	大小，数量，幅度
sinusoidal [sainəˈsɔidəl] *a.*	正弦曲线的
phasor [ˈfeizə] *n.*	相位复（数）矢量，相量
impedance [imˈpiːdəns] *n.*	[电] 阻抗
amplitude modulation (AM)	调幅
frequency modulation (FM)	调频
phase angle	相位角
lead network	超前网络
lag network	滞后网络

Exercises

Ⅰ. Match the items listed in the following two columns.

1. KCL	a. 调频
2. KVL	b. 调幅
3. amplitude modulation	c. 基尔霍夫电压定律
4. frequency modulation	d. 基尔霍夫电流定律
5. electronic device	e. 电子设备

Ⅱ. Complete the following sentences according to the text.

1. We will refer to any such interconnection as a circuit or a ______.
2. For a given circuit, a connection of two or more elements shall be called a ______.
3. At any node of a circuit, the currents algebraically sum to ______.
4. Around any loop in a circuit, the voltages algebraically sum to ______.

参考译文

基尔霍夫定律与线性电路分析

1. 基尔霍夫电流定律（KCL）

德国物理学家 Gustav Kirchhoff（1824～1887）得出了基尔霍夫电流定律，通过它我们可以分析许多电路元件（电压源、电流源和电阻）以及其他电子元器件的相互连接。我们把这样的一个相互连接称为电路或网络。

对一个给定的电路，两个或两个以上元件的连接点称为一个节点。现在我们给出两个基尔霍夫定律中的第一个——基尔霍夫电流定律（KCL），它实质上是电荷守恒定理：

对电路中的任何一个节点，在任一瞬时，流入某节点的电流和等于流出该节点的电流和，即

$$\sum i_{in} = \sum i_{out}$$

假定流入节点的电流为正，流出节点的电流为负，则可以得到 KCL 的等效变换形式。在这种情况下，基尔霍夫电流定律的变换形式可以表述如下：

对电路中的任一节点，电流的代数和为 0，即

$$\sum i = 0$$

2. 基尔霍夫电压定律（KVL）

现在我们给出基尔霍夫定律的第二个——电压定律。在介绍它之前，我们先引入“闭合回路”的概念。从电路的任一节点 n 开始，通过电路中每一个元件，再回到电路的出发节点 n 就形成一个闭合回路，其他任何一个节点只能通过一次。基尔霍夫电压定律是：

沿着电路的任一闭合回路，在任一瞬时，同一极性的电压和等于相反极性的电压和，即

$$\sum u_{+} = \sum u_{-}$$

假定元件两端的电压由正到负为正电压，由负到正为负电压（反之亦然），基尔霍夫电压定律也可以表述成下列形式：

绕电路中的任一闭合回路，电压的代数和等于 0，即

$$\sum u = 0$$

3. 正弦电路

在讨论电路突然接通电源或电路的输入信号是突变或不规则的时候，可用阶跃函数和脉冲函数来分析电路的响应，这就是暂态分析过程。但想了解一个电路对有规律的或者周期性输入信号的响应，目前为止最有用的稳态分析函数是正弦函数。

正弦函数是特别重要和常见的函数。首先日常家用电压是正弦的，其次无线电传输所用的信号不是调幅就是调频，调幅（AM）指正弦电压的幅度按照另外一些信号改变或调

制，调频（FM）指正弦电压的频率被调制。

对于正弦电路，我们有如下结论：

1）如果一个线性、稳态电路的输入是一个正弦信号，则它的响应是一个同样频率的正弦信号。

2）用实数或复数的正弦曲线可以求出一个正弦稳态响应的幅值和相位角。

3）如果一个正弦电路的输出响应比输入先到达它的峰值，则此电路是超前网络；否则，电路为滞后网络。

4）借助相量和阻抗的概念，正弦电路可以在频域内，以类似于电阻电路的方式，通过基尔霍夫电流定律、基尔霍夫电压定律、节点电压分析法、网孔电流分析法和回路分析法的相量（复数）形式进行分析。

Reading Material Field-Effect Transistors

Text

The field effect transistor or FET finds its greatest use in integrated circuit, especially in the digital area. The circuitry of a single chip often contains several thousand FETs, which are used not only as active devices but also as resistors and capacitors. Compared with general transistor, the FET has special properties of particular significance. One of these is the extremely high input resistance.

The MOSFET is the most commonly used FET. The letters MOS represent metal-oxide-semiconductor, and the device is often referred to as a MOS transistor, or simply MOS. MOS transistors are classified as P-channel or N-channel device, depending on the conductivity type of the **channel**(沟道)region. In addition, these devices can also be classified according to their **mode**(方式，模式)of operation as **enhancement**(增强)or **depletion**(耗尽，耗损) type device.

A simplified structure of a P-channel MOSFET is illustrated in Fig. 1-5. There are two P^+-type regions in the N-type substrate. One is called source region, which is represented electrically **isolate**(使隔离，使孤立)from the silicon by a very thin **insulator**(绝缘体). This insulator is usually an **oxide**(氧化物)and the most common choice is silicon dioxide (SiO_2).

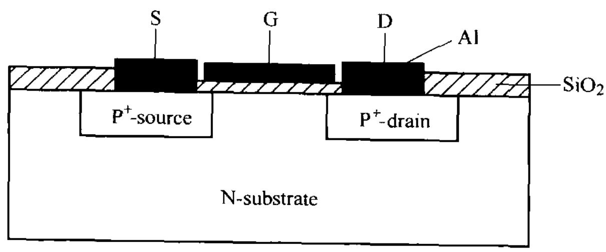

Fig. 1-5 Structure of a P-channel MOSFET

Now let us see how the MOSFET as Fig. 1-5 to operate in a circuit. We suppose that the substrate and gate terminals are connected to the source, along with a battery between D and S that makes, $U_{DS} = -6V$. Thus U_{GS} **initially**(最初,开头) is equal to zero. Then suppose U_{GS} is changed from zero to 10V with U_{DS} unchanged. The negative gate attracts positive holes. When U_{GS} is beyond a threshold value U_{th}, the positive holes are attracted more enough so that a localized inversion layer is formed directly below the gate. This serves as a conducting channel between the source and the drain **electrodes**(电极). As shown in Fig. 1-6, there is a continuous P region from the source to the drain and U_{DS} causes holes to flow from the source through the channel to the drain. This is a majority-carrier current, which flows by the drift process. Because their operation depends on only a single type of charge carrier, FET is **uniploar**(单极的) transistor. In contrast, the **bipolar**(双极的) junction transistor requires both hole and electron currents. In this case, we see that with zero gate voltage and U_{GS} positive, there is no conducting channel but when U_{GS} is sufficiently negative, a channel is formed and current flows. The more negative we make U_{GS}, the greater the current. A MOSFET that conducts appreciable current only when a nonzero voltage is applied to the gate is called an enhancement-mode field-effect transistor.

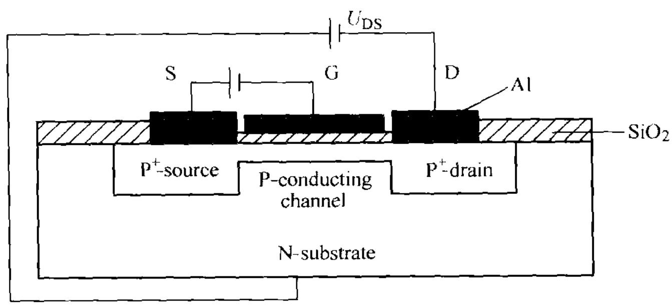

Fig. 1-6 Principle of a P-channel enhancement MOSFET

In a depletion-mode MOSFET, a conducting channel exists under the gate with no applied gate voltage. The applied gate voltage controls the current flow between the source and the drain by depleting a part of this channel. The operation of a depletion-mode MOSFET is very similar to that of the enhancement-mode MOS transistor. The depletion-mode MOSFET are often used in conjunction with enhancement-mode MOS transistors to serve as active loads, to improve the gain or the switching speed of the enhancement devices.

It is informative to compare the basic operation of a P-channel device with that of a PNP junction transistor. In the P-channel MOSFET the holes flow from the source through the channel to the drain, with the flow controlled by the gate voltage. In the PNP transistor the holes flow from the emitter through the base to the collector, with the flow controlled by the base current. Accordingly, there is a functional correspondence between the source and the emitter, the gate and the base, and the drain and the collector.