Unit 2

Introduction of Electronic Components

Lesson 1　Common Electronic Components

1. What is the unit of electrical resistance?
2. What are the types of transistor?
3. Please draw a capacitance symbol.

1. Resistor

The resistor is a component of a circuit that resists the flow of electrical current. It has two terminals through which electric current must pass. It is designed to drop the voltage of the current when it flows from one terminal to the other.

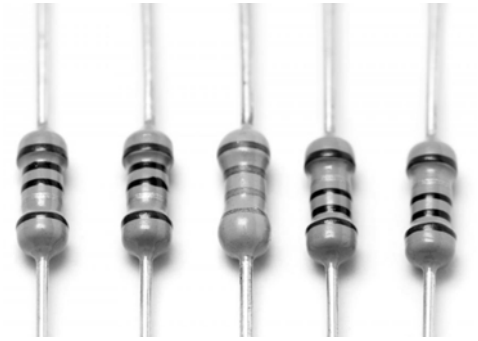

Fig.2-1 Resistor

Resistors are primarily used to create and maintain known safety currents within electrical components.

2. Capacitor

Capacitor is an electronic component that stores electric charge. The capacitor is made of two conductors (usually plates) that are separated by dielectric material. The electric charges accumulate on the plates when they are connected to power source. The positive charge accumulates on one plate and the negative charge accumulates on the the other.

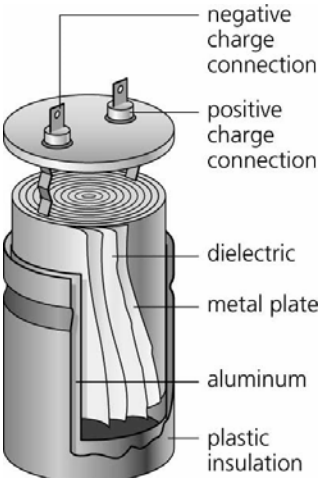

Fig.2-2 Capacitor

3. Diode

A diode is like one-way valve which allows electric current to flow in one direction but generally does not allow it to flow in the opposite direction. The direction of the electric current in the diode may be reversed. However, even if it is, the flow will still be one directional.

Fig.2-3 Diode

4. Transistor

The interior of a transistor contains two PN junctions, and has special devices with amplification ability. There are two kinds of NPN type and PNP type respectively. The two types of triode with different work characteristics can be mutually made up, and the so-called OTL circuit of the pipe is a PNP type and NPN type in matching use.

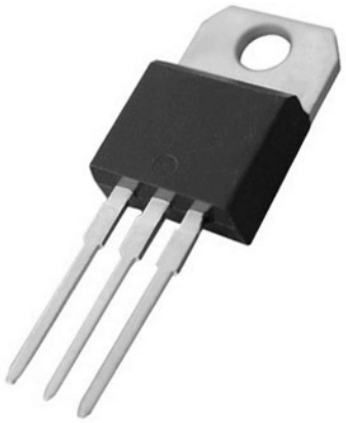

Fig.2-4 Transistor

5. Electronic Sensors

The devices that convert the mechanical input signals into electrical output signals are called electronic sensors. The output obtained from the electronic sensors can be read by the humans or it can be transmitted to controllers.

Fig.2-5 Electronic Sensors

6. Potentiometer

The potentiometer is also called pots and it is one of the most commonly used devices for measuring the displacement of the body. The potentiometer is a kind of resistive transducer or sensor and it works on the principle that the resistance of the wire will change with the change of wire length. The resistance of the wire is directly proportional to the length of the wire, thus as the length of the wire changes the resistance of the wire will also change.

Fig.2-6 Potentiometer

7. Vacuum Tube

The vacuum tube is an electron tube from which all or most of the gas has been removed, permitting electrons to move with no or low interaction with any gas molecules remained.

Fig.2-7 Vacuum Tube

Lesson 2　Light Emitting Diode

1. What is the effect of LED?
2. Please list the advantages of LED.

LED (Light Emitting Diode) is a solid state semiconductor device, which can directly convert electricity into light. The core of LED is a semiconductor chip. The chip is attached to a stent. One end is the negative side, and the other is attached to the cathode of the power source. The entire chip is packed by epoxy resin. Semiconductor chip is composed of two parts: one is the P-type semiconductor, whose inside is hole-dominated, and the other side is the N-type semiconductor, which is mainly electronic. But when linking the two semiconductors, between them a P-N junction will be-formed. When the current goes through the wires and affects this chip, electrons will be pushed to P zone, Electrons recombine the holes in P zones, and the energy will be radiated in the form of photon. This is the principle of LED lighting. The wavelength of light is the color of the light which is determined by the material forming P-N junction.

Conductor light-emitting diode (LED) is the third generation semi-conductor lighting source. It has many advantages:

(1) High Light Efficiency

The spectrum almost completely concentrates on visible light frequency. And the efficiency can reach 80%-90%. The visible light efficiency of the incandescent light with similar light effect is only 10%-20%.

(2) High Light Quality

As there is no ultraviolet and infrared ray in the spectrum, there is no heat and no radiation. It is typical green lighting source.

(3) Low Energy Consumption

The power of a single unit is generally 0.05-1W. And through clustering mode, different requirements can be met and it causes little waste. Ordinary

incandescent light with the same brightness can consume 8-10 times the energy of a LED.

(4) Long Life Span

30% of flux attenuation needs to spend 100, 1000 hours. Normally a semiconductor light has a life span of 50 years. Even if a person can live 100 years, he or she would use two lights at most.

(5) High Reliability and Durability

There is no tungsten wire, glass cover and so on that are easy to be broken, and abnormal rejection rate is very low and the maintenance costs are extremely cheap.

(6) Safe

The unit working voltage is roughly between 1.5-5V, and the working current is between 20-70mA.

(7) Green and Environmentally-friendly

The waste produced is recyclable and does not create pollution.

(8) Short Respond Time

It is suitable for frequent on-off and high frequent operation.

LED is a light emitting diode working through controlling semiconductor, usually composed of many red light. It can be used as screen to display text, graphics, images, animation, video, video signal and other information.

LED includes graphic display screen and video display screen, and both of them are composed of LED matrix block. Graphic display can display Chinese characters, English text and graphics in synchronization with the computer; Video display adopts microcomputer control and it can display graphic and image perfectly. It transmits all kinds of information in a real-time, synchronous and clear way. It can also display 2D and 3D animation, videos, TV, VCD programs and live shows. LED display shows are brightly colored and three-dimensional. Static displays are like painting, and moving displays are like film. It is widely used in finance, tax, business post, and telecommunications, sports, advertising, industrial enterprises, transport, education systems, stations, docks, airports, shopping malls, hospitals, hotels, banks, securities markets, construction market, auction houses, industrial enterprises management and other public places.

LED can display changing numbers, texts, graphics and images. It can be used for indoor environment and outdoor environment as well. Its advantages can not be matched with the projector, TV wall, LCD screen.

New Words and Expressions

resistor [rɪ'zɪstə] 电阻器
component [kəm'pəunənt] 成分，组件，元器件
capacitor [kə'pæsɪtə] 电容器，电容
charge [tʃɑ:dʒ] 电荷
conductor [kən'dʌktə] 导体，导管
dielectric [㎜daii'lektrik] 电介质，绝缘体
accumulate [ə'kju:mjuleit] 堆积，积累
diode ['daiəud] 二极管
current ['kʌrənt] 电流
transistor [træn'sistə] 晶体管
amplification [㎜æmpləfɪ'keɪʃən] 放大
triode ['traɪ㎜əʊd] 三极管，发射极
transducer [trænz'dju:sə] 传感器，变换器
potentiometer [pə㎜tenʃi'ɔmitə] 电位器
principle ['prinsəpl] 原则，原理，准则
vacuum ['vækjuəm] 真空，空白
molecule ['mɔlikju:l] 分子；微小颗粒
semiconductor [㎜semikən'dʌktə] 半导体
chip [tʃip] 芯片
epoxy [e'pɔksi] 环氧的
resin ['rezɪn] 树脂，合成树脂
photon ['fəʊ㎜tɔn] 光子，光量子
frequency ['fri:kwənsi] 频率，次数
luminous ['lu:minəs] 发光的，明亮的
infrared ['infrə'red] 红外线
tungsten ['tʌŋstən] 钨

animation [æənə'meɪʃən] 动画
synchronize ['sɪŋkrəænaɪz, 'sɪn-] 同时发生
dimension [di'menʃən] 度，维
static ['stætik] 静止的，静电的
vacuum tube 真空管
light-emitting diode 发光二极管
electrical transducer 电子传感器

Exercises

1．Please translate the following sentences into Chinese.

(1) Important specifications to consider when shopping for an LCD monitor include contrast ratio, brightness (or "nits"), viewing angle, and response time.

(2) LCDs use only one-third to one-half the electricity of their CRT counterparts. They are much easier on the eyes, take up 90% less space, and only weigh a few pounds.

2．Please translate the following sentences into English.

(1)发光二极管是一种固态的半导体器件，它可以直接把电转化为光。LED 的核心是一个半导体的晶片，晶片的一端附在一个支架上，一端是负极，另一端连接电源的正极，整个晶片被环氧树脂封装起来。

(2) LED 通过控制半导体发光二极管来显示，由很多个通常是红色的小灯组成，靠灯的亮灭来显示字符。用来显示文字、图形、图像、动画、行情、视频、录像信号等各种信息。

Reading Material

1 What Are Strain Gauges?

It is often easy to measure the parameters like length, displacement, weight etc that can be felt easily by some senses. However, it is very difficult to measure the dimensions like force, stress and strain that cannot be really sensed directly by any instrument. For such cases special devices called strain gauges are very useful. There are some materials whose resistance changes when strain is applied to them or when they are stretched and this change in resistance can be measured easily. For applying the strain you need force, thus the change in resistance of the material can be calibrated to measure the applied force. The devices whose resistance changes are due to applied strain or applied force are called the strain gauges.

1. Principle of Working of Strain Gauges

When force is applied to any metallic wire, its length will increase due to the strain. The more is the applied force, the more is the strain and the more is the increase in length of the wire. If L1 is the initial length of the wire and L2 is the final length after application of the force, the strain is given as:

$\varepsilon = (L2-L1)/L1$

Further, as the length of the stretched wire increases, its diameter decreases.

Now, we know that resistance of the conductor is the inverse function of the length. As the length of the conductor increases its resistance increases. This change in resistance of the conductor can be measured easily and calibrated against the applied force. Thus strain gauges can be used to measure force and related parameters like displacement and stress.

The input and output relationship of the strain gauges can be expressed by the term gauge factor or gauge gradient, which is defined as the change in resistance R for the given value of applied strain ε.

2. Materials Used for the Strain Gauges

Earlier wire types of strain gauges were used commonly, which are now being replaced by the metal foil types of gauges as shown in the figure below. The metals can be easily cut into the zigzag foils for the formation of the strain gauges. One of the most popular materials used for the strain gauges is the copper-nickel-manganese alloy, which is known by the trade name "Advance". Some semiconductor materials can also be used for making the strain gauges.

3. Applications of the Strain Gauges

The strain gauges are used for two main purposes:

(1) Measurement of strain: Whenever any material is subjected to high loads, they come under strain, which can be measured easily with the strain gauges. The strain can also be used to carry out stress analysis of the member.

(2) Measurement of other quantities: The principle of change in resistance due to applied force can also be calibrated to measure a number of other quantities like force, pressure, displacement, acceleration etc since all these parameters are related to each other. The strain gauges can sense the displacements as small as 5 μm. They are usually connected to the mechanical transducers like bellows for measuring pressure and displacement and other quantities.

2 What Is a LCD Monitor?

LCD displays were used on laptop computers before the technology improved enough to make the jump to desktop monitors. An LCD monitor consists of five layers: a backlight, a sheet of polarized glass, a "mask" of colored pixels, a layer of liquid crystal solution responsive to a wired grid of x, y coordinates, and a second polarized sheet of glass. By manipulating the orientations of crystals through precise electrical charges of varying degrees and voltages, the crystals act like tiny shutters, opening or closing in response to the stimulus, thereby allowing degrees of light that have passed through specific colored pixels to illuminate the screen, creating a picture.

As LCD technology evolves, different techniques for producing color

emerge.

Active-matrix or TFT (thin film transistor) technology produces color and images as sharp as any CRT and is generally considered superior to passive-matrix technologies.

Fig.2-8 LCD

Important specifications to consider when shopping for an LCD monitor include contrast ratio, brightness (or "nits"), viewing angle, and response time.

Contrast ratio relates to the display's comparative difference between its brightest white values and its darkest black values. A higher contrast ratio will have truer colors with less "wash out". The standard offering for lower end models is commonly 350:1. Many experts recommend a contrast ratio of 500:1 or better.

An LCD monitor is brighter than a CRT, giving the consumer little reason to hunt for an especially bright model. Brightness is measured in nits, or one candela per square meter. Anywhere from 250-300 nits is standard. If the nits are much higher you'll likely end up adjusting the brightness way down.

The viewing angle is an especially important consideration if you plan to have multiple people viewing the LCD monitor at any given time. There is a vertical and a horizontal viewing angle specification, which refers to the degree you can stray from dead center before the picture starts to wash out. High contrast levels usually go hand-in-hand with wider viewing angles. Many recommend a viewing angle of at least 140 degrees horizontal and 120 degrees

vertical. The wider the viewing angles, the better.

Response time is measured in milliseconds (ms) and refers to how long it takes pixels to turn from completely white to black and back again. Smaller values represent a faster response time and are more desirable, especially for gaming or viewing video. If the response time is slow, "ghosting" or "trailing" can occur with fast-moving images, as repaints of the screen overlap. A maximum response time should be no more than 25ms for general use, and 17ms is better. Many gamers report no ghosting using an LCD monitor with a response time of 16ms or less.

LCDs use only one-third to one-half the electricity of their CRT counterparts. They are much easier on the eyes, take up 90% less space, and only weigh a few pounds. They also emit far less low-frequency radiation than CRTs. This makes LCDs a great choice for nearly everyone, and ideal for people who work all day in front of the screen. Colors may change hue as one moves to the outer limits of the viewing angle, particularly on displays with narrow viewing angles and low contrast ratios. For this reason graphics professionals that require exacting color consistency regardless of viewing angle generally use CRTs, though LCDs have improved in this regard.

An LCD monitor comes in standard sizes from 15 inches to 21 inches, and larger. The viewing screen is the same size as the rated display, unlike CRT monitors. Therefore a 15-inch LCD will have a 15-inch viewing screen.

A potential weak link of an LCD monitor is the backlight. Many monitors come with a 3-year warranty, but stipulate 1 year for the backlight. Models with 3-year warranties that cover the backlight usually cost a little more but may be worth the extra investment.

参考译文：

第一课　常用电子元件

1. 电阻器

电阻是阻挡电流流动的电路元件。它有两个接线端子，电流必须从其间流过，电阻被用来在电流从一端流向另一端时降低电流的电压。

电阻主要用于在电气元件上创建和维护已知的安全电流。

2. 电容器

电容器是储存电荷的电子元件。电容器由两个导体（通常呈板状）构成，它们被绝缘材料隔开。当板块与电源相连时，电荷就积累在极板上。其中正电荷积累在一块极板上，负电荷积累在另一块极板上。

3. 二极管

二极管如同单向阀，允许电流在一个方向流动，但一般不允许它向相反的方向流动。二极管的电流方向可能被逆转，然而，即使是这样，电流仍然是往一个方向。

4. 晶体管

晶体管内部含有两个 PN 结，且具有带放大功能的特殊器件。NPN 型和 PNP 型各自分为两种。具有不同工作特性的两种三极管可以相互弥补，管道的所谓的 OTL 电路是一个 PNP 型和 NPN 型匹配使用。

5. 电子传感器

将输入的机械信号转换为电信号输出的设备称为电子传感器。从传感器得到的输出信号由人工识读，也可以将其传送给控制器。

6. 电位计

电位计也被称为电压计，是用于测量物体位移的最常用设备之一。电位计是电阻变换器或传感器，其工作原理是导线的电阻随其长度的变化而变化，导线的电阻与其长度成正比，改变导线的长度，导线的电阻也将随之改变。

7. 真空管

真空管是一种内部气体被全部或部分抽空的电子管，电子可以在与剩余气体分子没有相互作用或仅有很小的相互作用的情况下运动。

第二课　发光二极管

LED（发光二极管），是一种固态的半导体器件，它可以直接把电转化为光。LED 的核心是一个半导体芯片，晶片的一端附在一个支架上，一端是负极，另一端连接电源的正极，整个晶片被环氧树脂封装起来。半导体晶片由两部分组成，一部分是 P 型半导体，在它里面空穴占主导地位，另一端是 N 型半导体，在这边主要是电子。但这两种半导体连接起来的时候，它们之间就形成一个“P-N 结”。当电流通过导线作用于这个晶片的时候，电子就会被推向 P 区，在 P 区里电子跟空穴复合，然后就会以光子的形式发出能量，这就是 LED 发光的原理。而光的波长也就是光的颜色，是由形成 P-N 结的材料决定的。

导体发光二极管（LED）是第三代半导体照明光源。这种产品具有很多优点：

（1）光效率高

光谱几乎全部集中于可见光频率，效率可以达到 80%～90%。而光效差不多的白炽灯可见光效率仅为 10%～20%。

（2）光线质量高

由于光谱中没有紫外线和红外线，故没有热量，没有辐射，属于典型

的绿色照明光源。

（3）能耗小

单体功率一般在 0.05～1 W ,通过集群方式可以量体裁衣地满足不同的需要，浪费很少。作为光源，普通白炽灯在同样亮度下是其耗电量的 8～10 倍。

（4）寿命长

光通量衰减到 70% 的标准寿命是 10 万小时。一个半导体灯正常情况下可以使用 50 年，即使长命百岁的人，一生最多也就用 2 只灯。

（5）可靠耐用

没有钨丝、玻壳等容易损坏的部件，非正常报废率很低，维护费用极为低廉。

（6）安全

单位工作电压大致在 1.5-5 V 之间，工作电流在 20-70 mA 之间。

（7）绿色环保

废弃物可回收，没有污染。

（8）响应时间短

适应频繁开关以及高频运作的场合。

LED 是一种通过控制半导体发光的二极管，通常由很多红色的小灯组成，靠灯的亮灭来显示字符。用作显示屏幕以显示文字、图形、图像、动画、行情、视频、录像信号等各种信息。

LED 显示屏分为图文显示屏和视频显示屏，均由 LED 矩阵块组成。图文显示屏可与计算机同步显示汉字、英文文本和图形；视频显示屏采用微型计算机进行控制，图文、图像并茂，以实时、同步、清晰的信息传播方式播放各种信息。它还可显示二维、三维动画、录像、电视、VCD 节目以及现场实况。LED 显示屏显示画面色彩鲜艳，立体感强，静如油画，动如电影，广泛应用于金融、税务、工商、邮电、体育、广告、厂矿企业、交通运输、教育系统、车站、码头、机场、商场、医院、宾馆、银行、证券市场、建筑市场、拍卖行、工业企业管理和其他公共场所。

LED 显示屏可以显示变化的数字、文字、图形图像；不仅可以用于室内环境还可以用于室外环境，具有投影仪、电视墙、液晶显示屏无法比拟的优点。