



模块 2

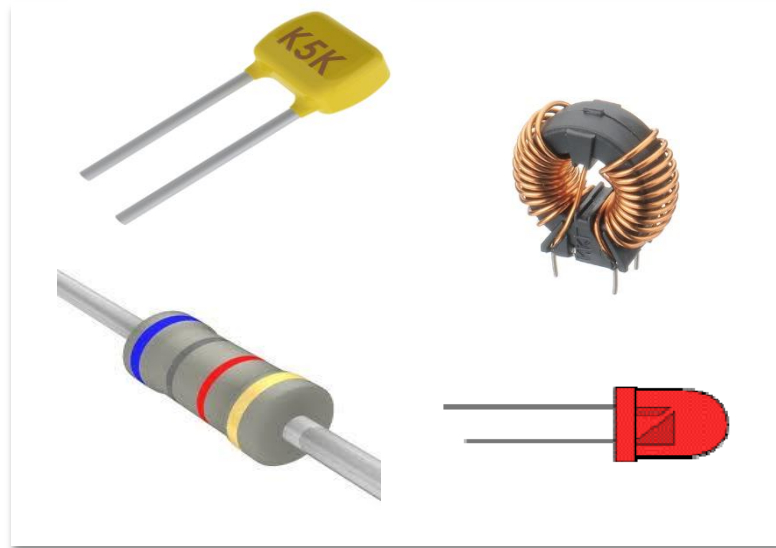
讲解：电压、电流和功率



电压、电流和功率

本模块中您将学到

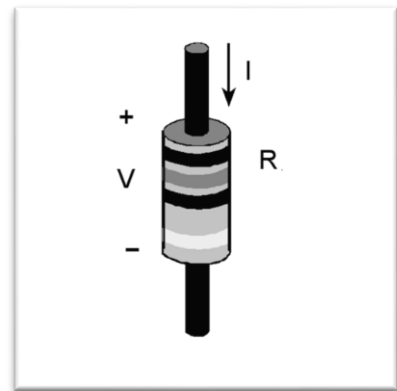
- 电路理论中的概念
 - 电压, V (伏特)
 - 电流, I (安培)
 - 能量, E (焦耳)
 - 功率, P (瓦特)
- 电子元器件
 - 电阻
 - 电容
 - 电感
 - 发光二极管 (LED)
- Test Equipment 测量仪器
 - 电压表、欧姆表、电流表
 - 示波器





电流

- 电流的定义
 - 电流是由电子移动形成的
 - 电流符号为 I ，单位是安培 (A)
 - 1安培的电流等于每秒钟 6.241×10^{18} 个电子移动
 - 1安培电流 = 1库伦/秒
- 电流的特性
 - 有方向，沿导体流动
 - 会刺激肌肉和神经
 - 可以驱动机器人的电机
 - 遵循欧姆定律 ($V = IR$)
- 电流的测量
 - 电路中的电流可以通过电流表来测量
 - 电阻上的电压 $V = I * R$

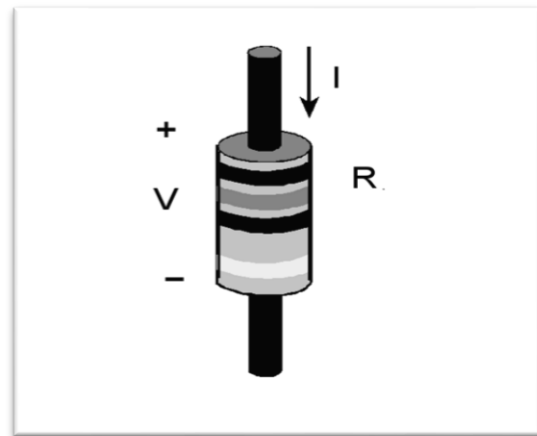


**MSP432可以提供或吸收最大
6 mA的电流**



电压

- 电压的定义
 - 电压是由两点之间的电势差形成的
 - 电压符号为V，单位是伏特
 - 电动势或电势差可以产生电流
- 电压的特性
 - 电压始终表示的是一个差值
 - 电压有正负，其正负决定电流流动方向
 - 机器人套件中的电机是由电池驱动的
 - 遵循欧姆定律
- 电压的测量
 - 电压表可以测量直流和交流电压
 - 示波器测量的是电压随时间变化的波形
(V v/s t)



MSP432可以输出0V或3.3V



能量和功率

- 能量的定义
 - 对于电池来说，是指所存储能量的大小
 - 能量的单位是焦耳（焦耳=伏特*安培*秒）
 - $E=1J$ 相当于 1V 电压及 1A 电流持续 1 秒
- 电池
 - 电压是恒定的
 - 容量由安培-小时来表示
- 功率
 - 表示消耗电能的快慢
 - $P = V \cdot I$
 - 功率的单位是瓦特 = 焦耳/秒 = 伏特*安培
 - 可以在以下形式中转换：电能，光能，机械能，热能，声能

MSP432在3.3V供电下要消耗5mA电流

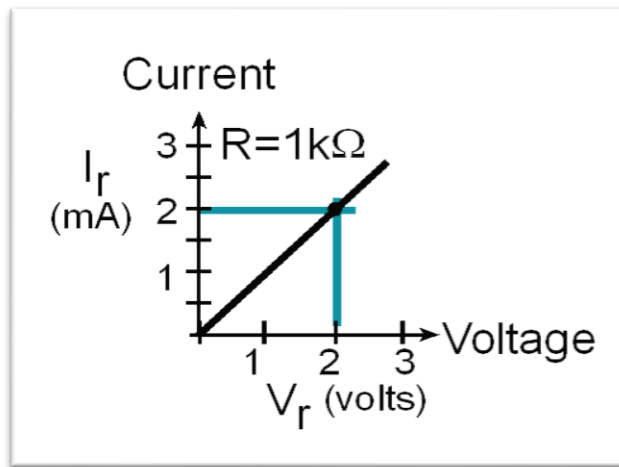
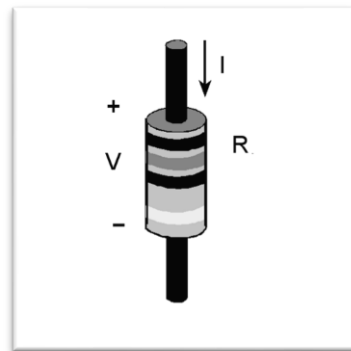
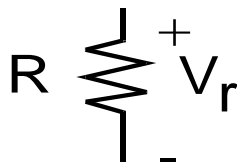
**AA碱性电池电压为1.5V，容量为
2 A-h**

**功率计算：
2节AA电池可以给MSP432供电持
续16天， $2000 \text{ mA-h} = 5\text{mA} \cdot 400\text{h}$**



电阻

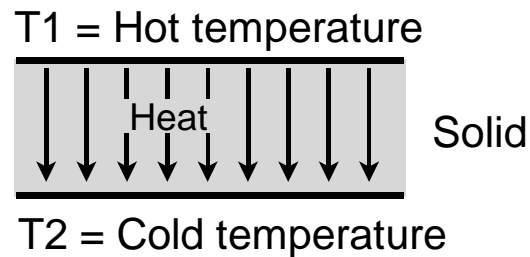
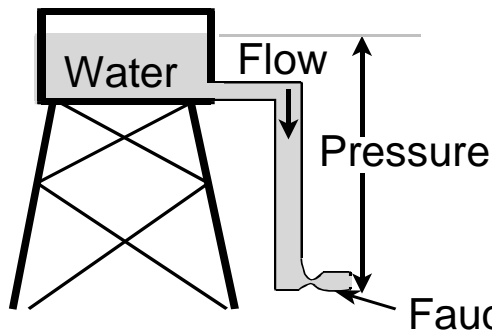
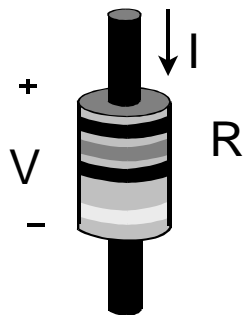
- 电阻的定义
 - 拥有线性电压-电流关系的无源器件
 - 电阻单位为欧姆 (Ω)
 - 电阻遵循欧姆定律
- 电阻的参数
 - 精度, 如 5% ($1000 \Omega \pm 5\%$)
 - 最大功率, 瓦特 ($\frac{1}{4} \text{ watt} = 250 \text{ mW}$)
 - 当电压 = 2 V, 电流 = 2 mA时, 功率 = $2 * 2 \text{ mA} = 4 \text{ mW}$
- 电阻的用途
 - 限制或控制电流大小
 - 在电路中影响增益、偏置和频率响应





类比

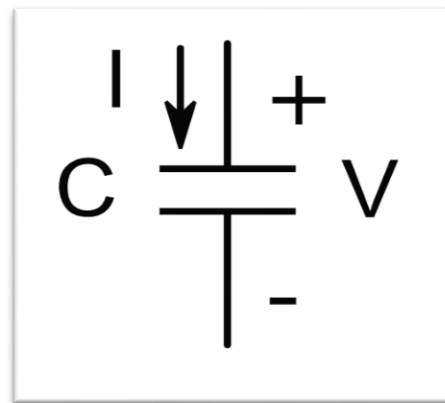
- 电流 = 电压/电阻
- 液体流量 = 压力/阻力
- 热流量 = 温度/热阻





电容

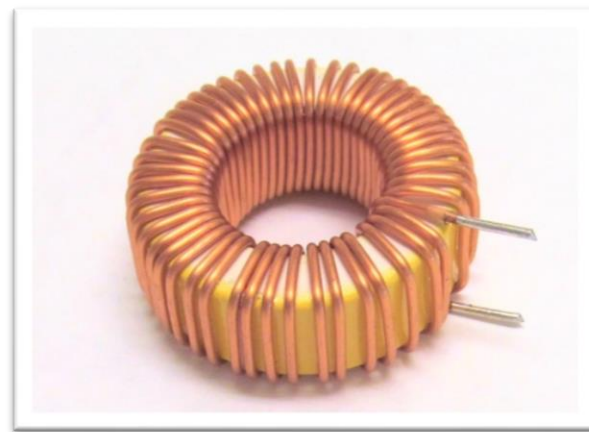
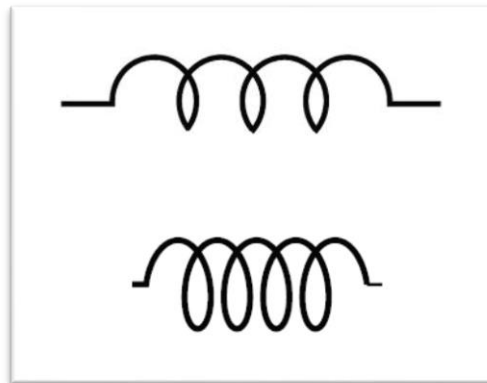
- 电容的定义
 - 可以储存电荷的一种无源器件
 - 有复阻抗, $Z = 1/(j2\pi fC)$
 - 通过直流电时相当于开路
 - 允许交流电通过
 - 电抗, $|V|/|I| \equiv X = 1/(2\pi fC)$
- 电容的参数
 - 在电路中用 **C** 表示, 单位是法拉 (F)
 - 精度, 如 5%
 - 最大耐压
 - 类型, 如陶瓷电容、钽电容等
- 电容的用途
 - 用来临时储存电能
 - 用来改变电路的频率响应
 - 用来减小电路中的噪声





电感

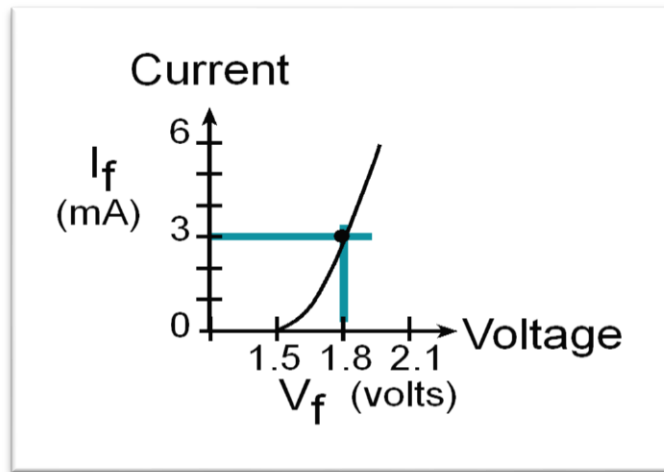
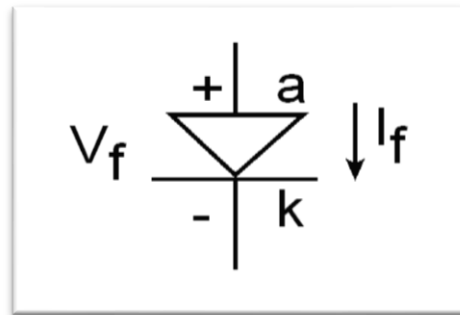
- 电感的定义
 - 由绕在磁芯上的导线组成的无源器件
 - 复阻抗 $V/I \equiv Z = j2\pi fL$
 - 直流时相当于短路
 - 阻碍交流
- 电感的参数
 - 在电路图中用 L 表示，单位是亨利 (H)
- 电感的用途
 - 用来制造直流电机





发光二极管 (LED)

- LED的定义
 - 一种可以发光的半导体元件
 - 可以将电能转化为光能
 - 只能单向导通
- LED的参数
 - 电压, 电流
 - 效率, 亮度
 - 尺寸
- LED的用途
 - 照明, 显示, 传感器
 - 隔离电路, 光纤传输



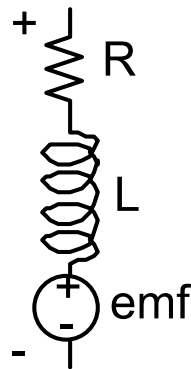


直流电机

- 直流电机的定义
 - 一种机电设备
 - 可将电能转化为机械能
 - 可以向两个方向转动
- 直流电机的参数
 - 电压，电流
 - 效率，扭矩
 - 尺寸，重量
- 直流电机的用途
 - 机器人执行机构



Electrical Model



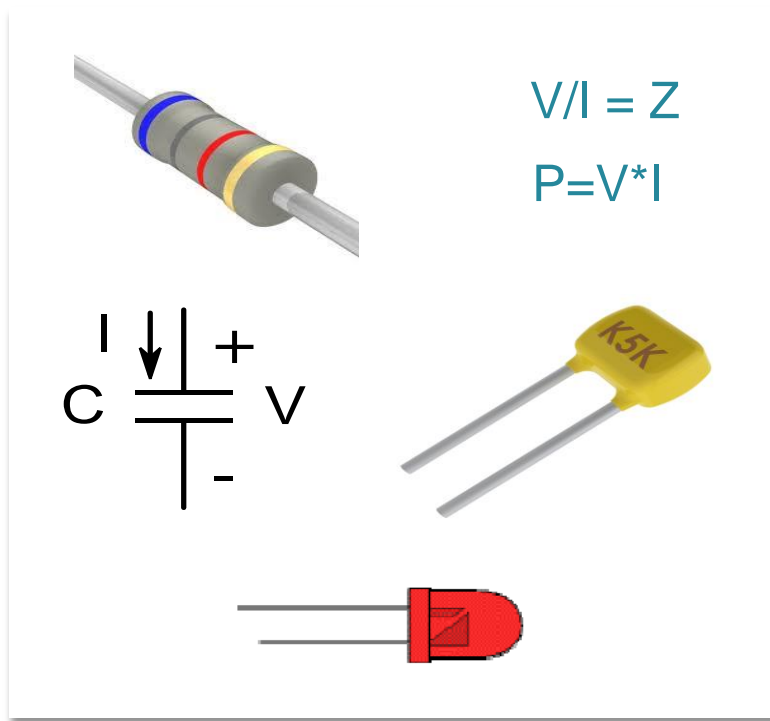
- 电阻 R
- 电感 L
- 反向电动势 emf (V)



电压、电流和功率

总结

- 电阻
 - 电压，电流，功率
 - 欧姆定律 $V=I \cdot R$
- 电容
 - 电压，电流
 - 电抗, $X = 1/(2\pi fC)$
 - 复阻抗, $Z = 1/(j2\pi fC)$
- 电感
 - 电压，电流
 - 复阻抗, $Z = j2\pi fL$
- 发光二极管 (LED)
 - 电压，电流，功率
 - 单极性
 - 非线性



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