



**LaACES
Student
Ballooning
Course**

Introduction to Electronics

LaACES, Lecture 02.01



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- What should you already know?
 - Definitions of electrical quantities
 - Electric potential (volts, millivolts, microvolts)
 - Electric current (amperes, milliamps, microamps)
 - Electrical resistance (ohms, kilo-ohms, mega-ohms)
 - Electric power (watts, kilowatts, milliwatts)
 - Ohms Law and power relationships
 - For DC circuits
 - For AC circuits



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Electric Potential

1 volt = 1 joule of energy per coulomb of charge

Some examples:

flashlight battery – 1.5 V (DC)

car battery – 12 V (DC)

wall socket – 120 V (AC)

overhead power lines – 6,000 to 250,000 V (AC)



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Electric Current

1 ampere = movement of 1 coulomb of charge per time interval of 1 second

Some examples:

Flashlight – 300 milliamps (DC)

Toaster – 10 amperes (AC)

Automobile starter – 150 amperes (DC)

Quartz wristwatch – a few microamps (10^{-6} ampere)

Enough to “shock” – a few milliamps (10^{-3} ampere)



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Electric Resistance

1 ohm (Ω) of resistance allows a potential of 1 volt to cause a current of 1 ampere to flow in a circuit

Ohms's Law $V = I R$

V = potential in volts

I = current in amperes

R = resistance in oms



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Electric Power

1 watt of power is produced when a potential of 1 volt causes a current of 1 ampere to flow in a circuit

$$P = I V$$

V = potential in volts

I = current in amperes

R = resistance in ohms

P = power in watts

Using Ohm's Law and $P = I V$, then $P = I^2 R = V^2 / R$



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Electric Power

Some examples...

Quartz wristwatch – 0.000001 watt (1 microwatt)

Flashlight – 1 watt

Balloon radio beacon – 5 watts

Table lamp – 60 watts

27" television set – 130 watts

Hair dryer – 1100 watts

Clothes dryer – 5000 watts (5 kilowatts)

State of Louisiana – 8,000,000,000 watts (8000 megawatts)



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How To Use a Digital Multimeter

Digital MultiMeter (DMM)

Measures voltage, current, resistance,
sometimes other parameters

This one cost less than \$5

AC and DC voltage

DC current

Resistance

Diode and Transistor properties

Battery tester





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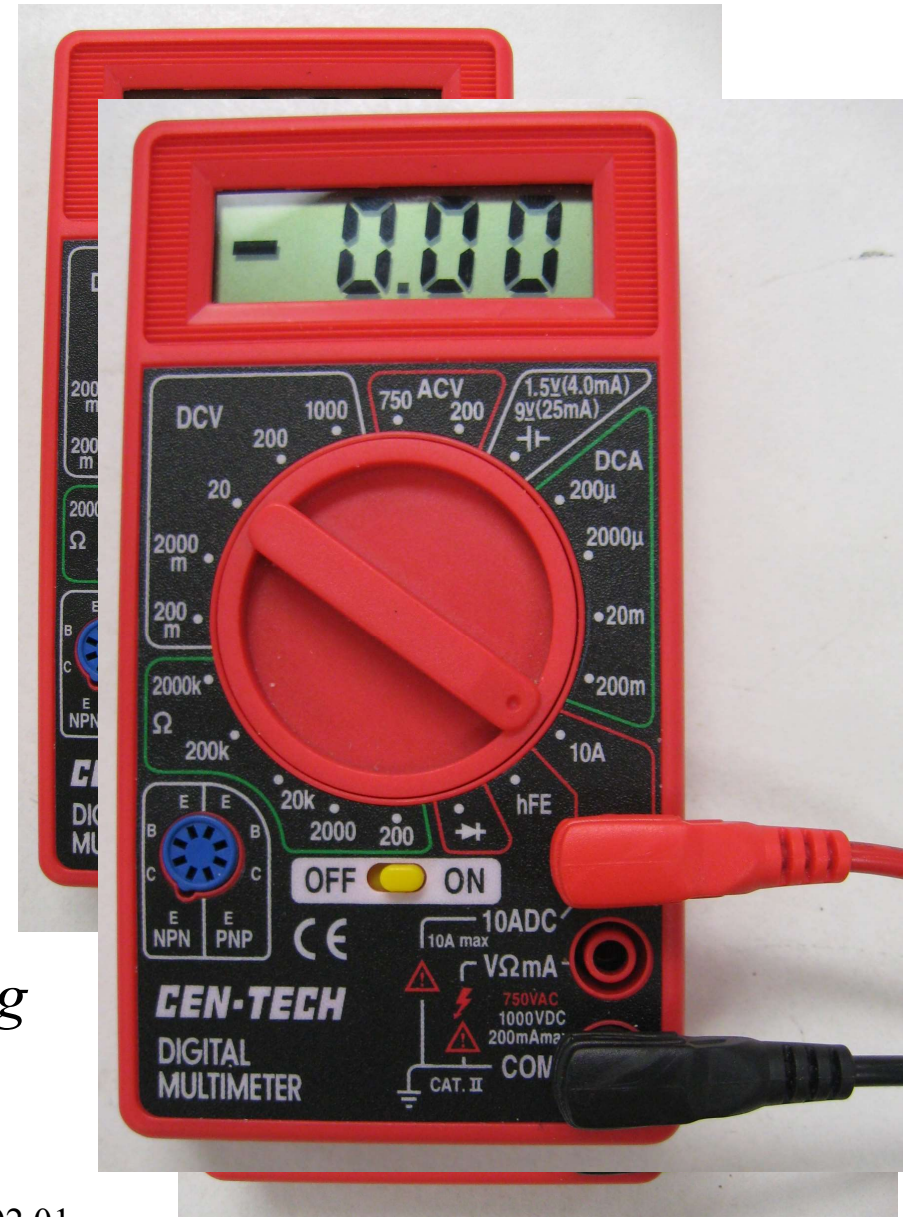
Taking Measurements

BLACK test lead is plugged
Into the **COM** (common)
terminal

For large DC currents
RED test lead is plugged
(up to 10 amperes)
Into the **VΩmA** terminal
RED test lead is connected
terminal
To the **10ADC** terminal

Select the proper RANGE

Some \$\$ DMMs are *autoranging*

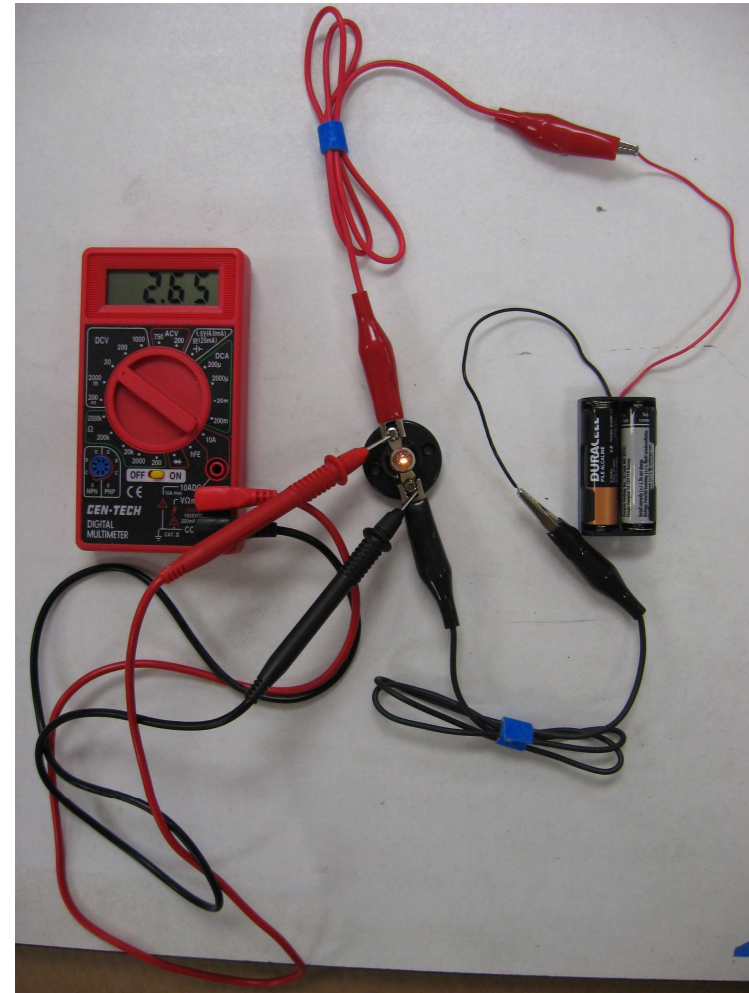
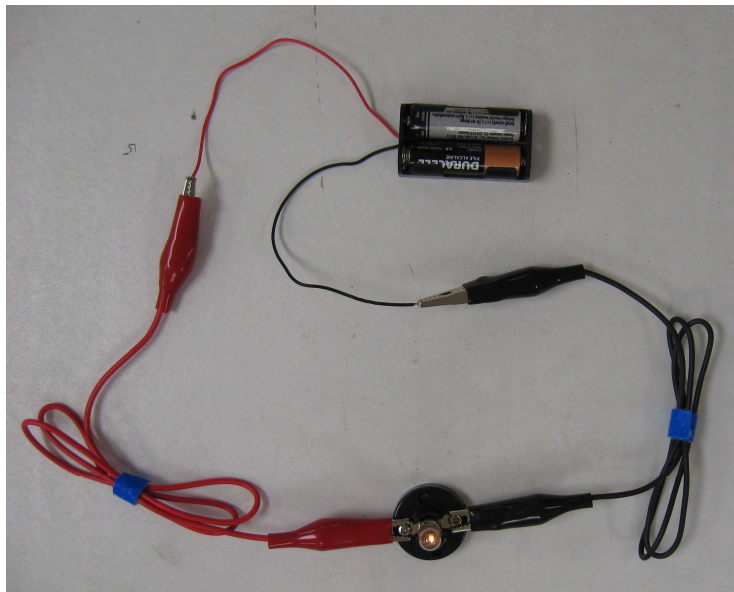




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Voltage measurements require the DMM to be connected in *parallel* (i.e., *across*) the circuit element whose voltage is being measured

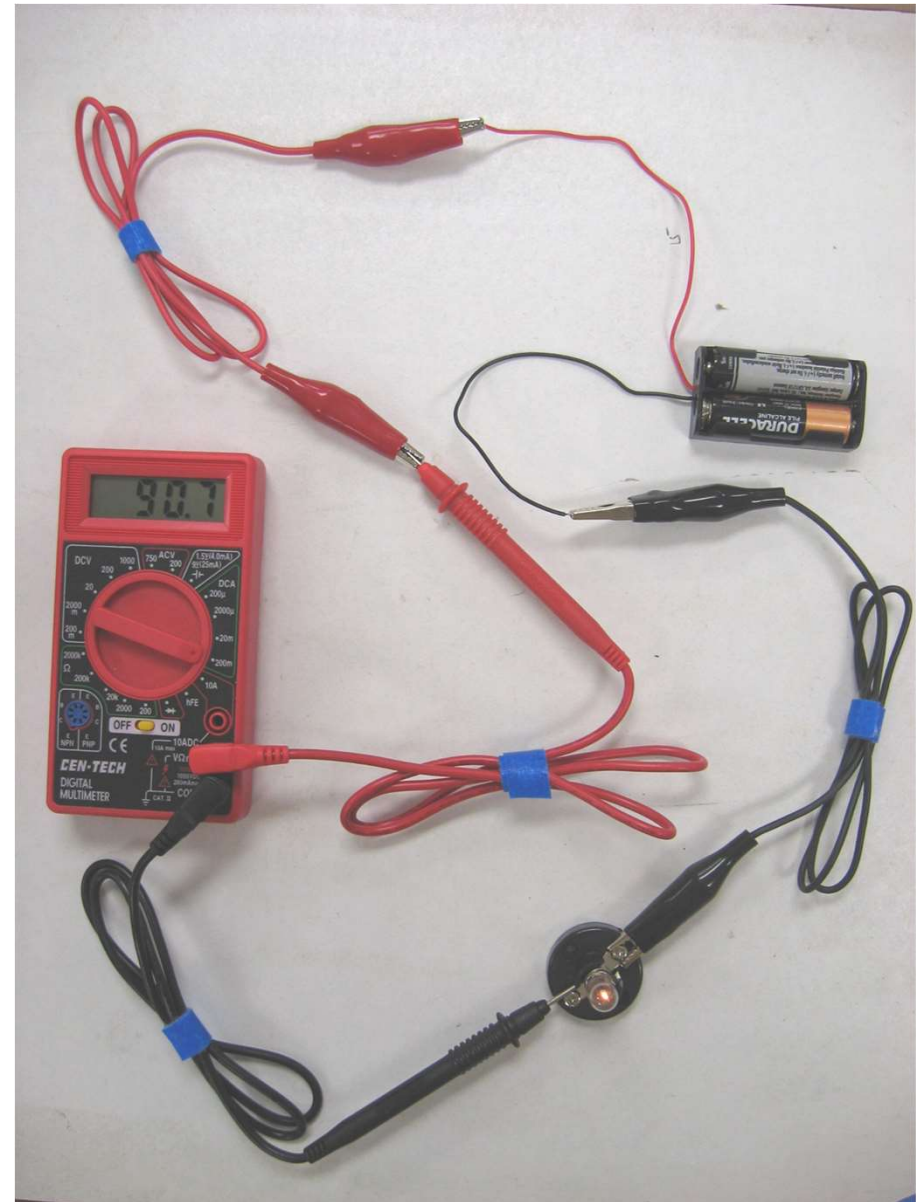
Let's measure the voltage
Here's a simple battery
and lamp circuit





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To measure current, the DMM must be connected *in series* (i.e., *in line with*) the circuit element whose current is being measured

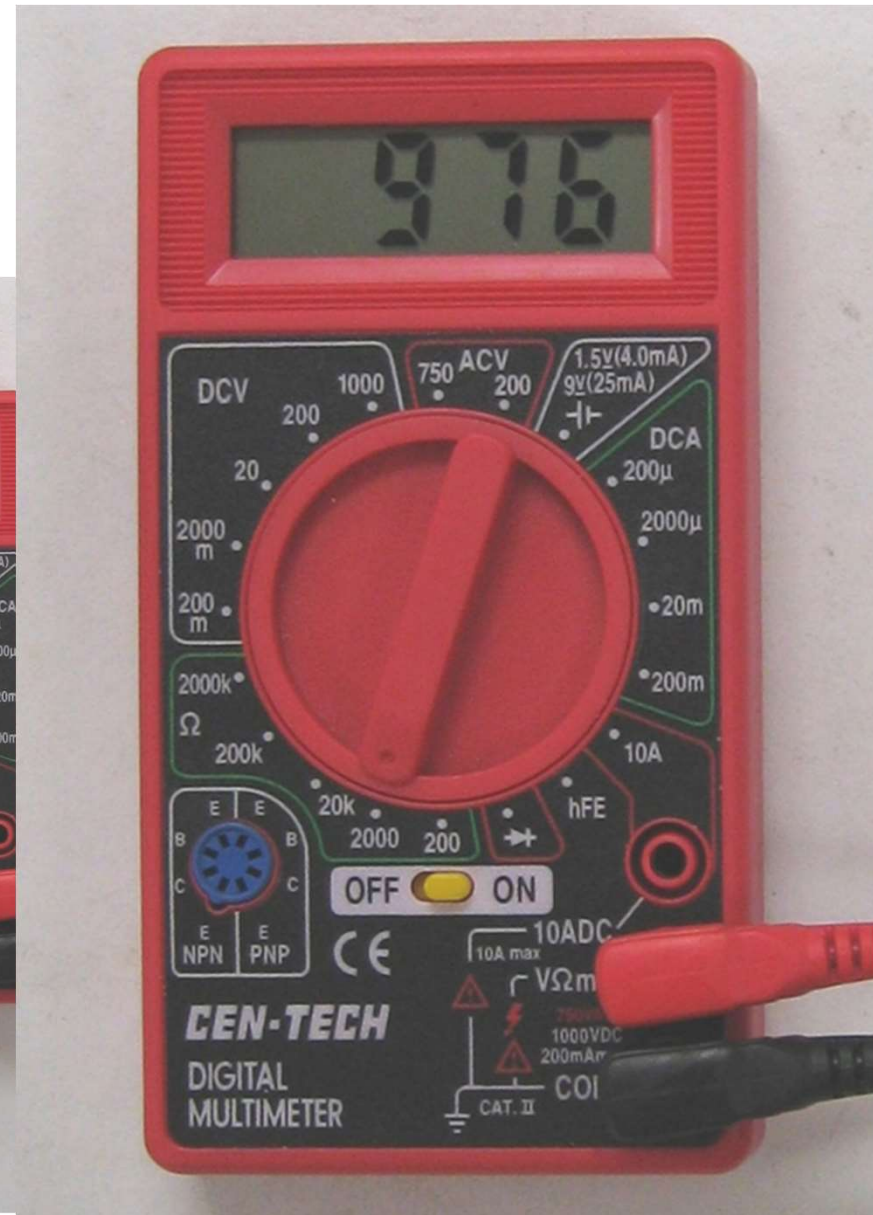
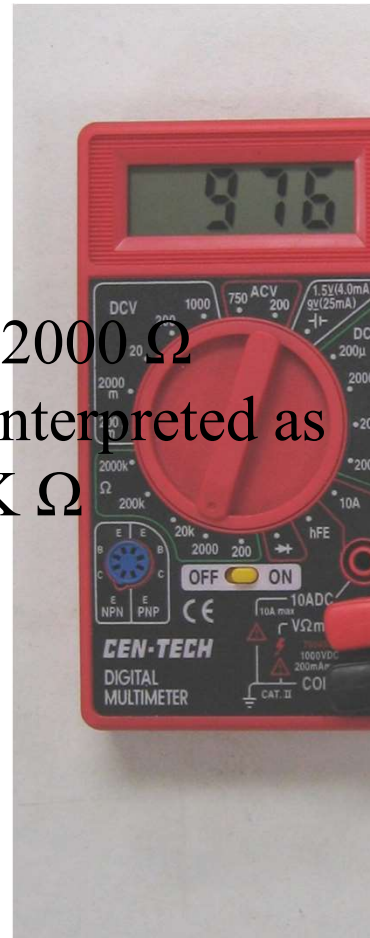




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Here's how to
measure the
resistance of an
element. The RANGE is 0-2000 Ω
So the reading is interpreted as
976 Ω , or 0.976 K Ω

Note: the element
is removed from
its circuit



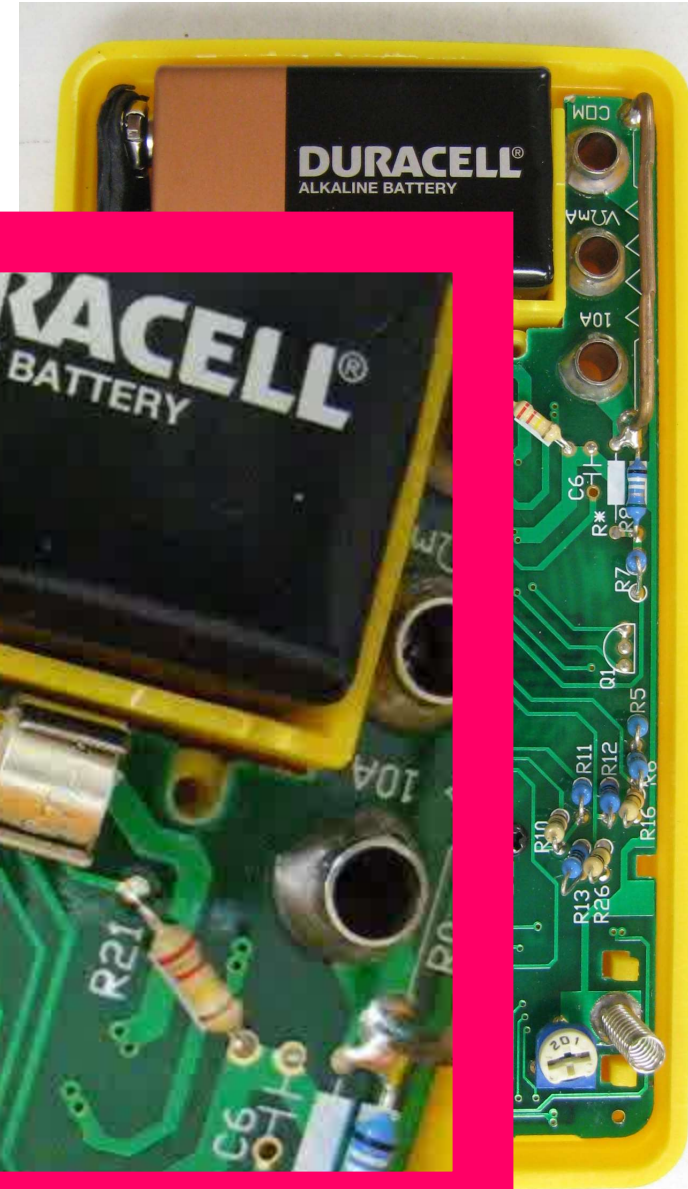
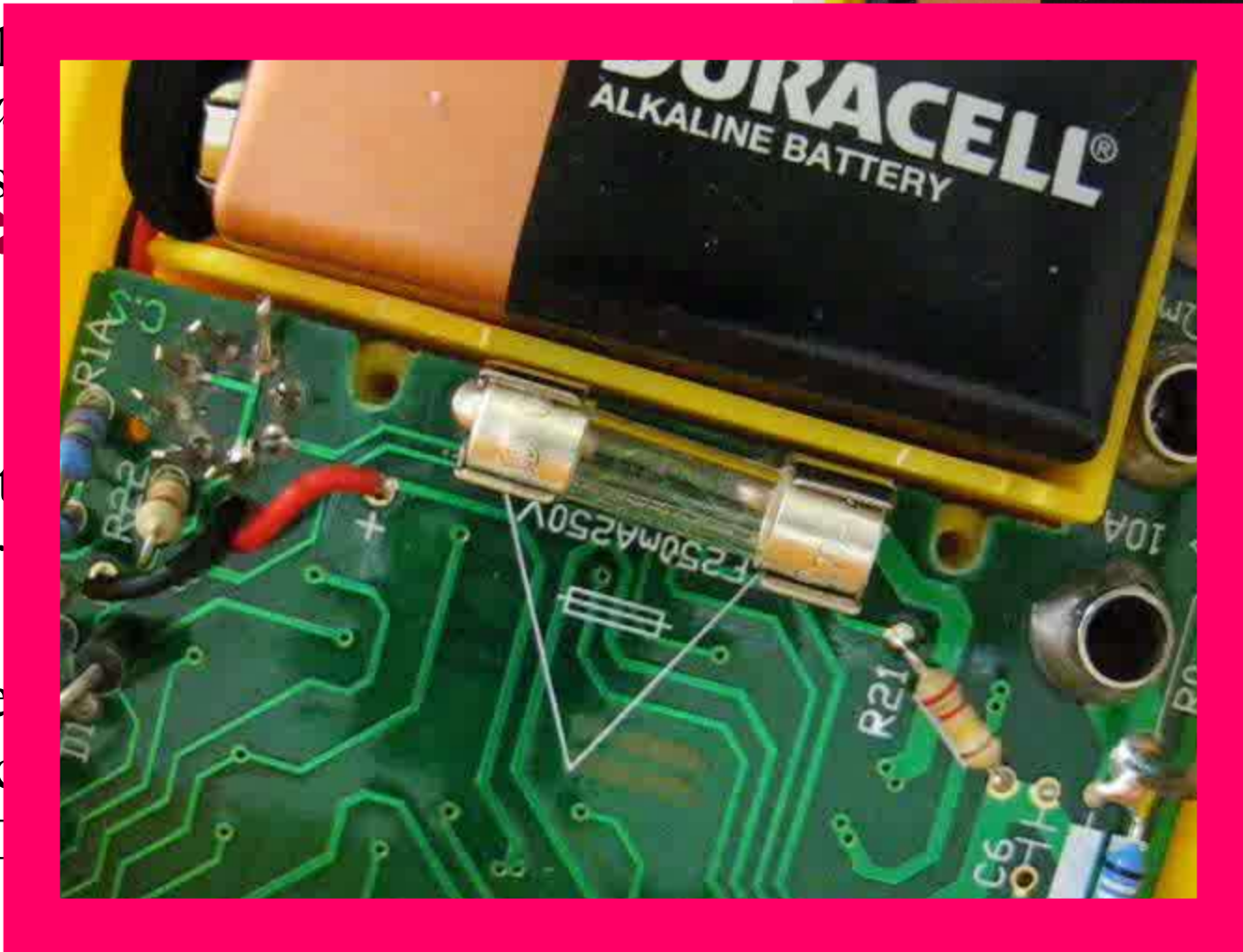


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What happens if you
set to read
voltage sensor
✿ ✿ ✿

Some of the
Escape from
We

Fortunately
DMM included
So your I





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Activity A02.01

Practice making measurements with a digital multimeter. **Without blowing any fuses!**

Practice calculating resistance and power using Ohm's Law and the power relation.