H01 Lab: Protected Low-Voltage Circuit

Predict, simulate, build, measure, troubleshoot, reflect

Technology Commons

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Module: H01 **Lab:** L01 **Time:** 75 minutes **Safety:** Protected extra-low voltage

Document role: This lab contains equipment, safety, physical procedure, measurements, approved faults, and cleanup. Bring completed worksheet predictions and simulation evidence rather than copying them again.

Learning goal

Identify source, conductors, control, protection, and load; predict current; place meters correctly; build safely; and diagnose one teacher-approved open fault.

Stop conditions

Stop and disconnect power for heat, smell, smoke, damaged insulation, unexpected current, unstable connections, a dropped metal object, a meter lead in the wrong jack, or any uncertainty about the circuit.

Equipment

- current-limited 9 V classroom supply or battery holder
- 500 mA fuse and holder
- switch, red LED, $330\ \Omega$ resistor rated at least 0.25 W
- breadboard, short insulated jumpers, DMM, and eye protection as directed

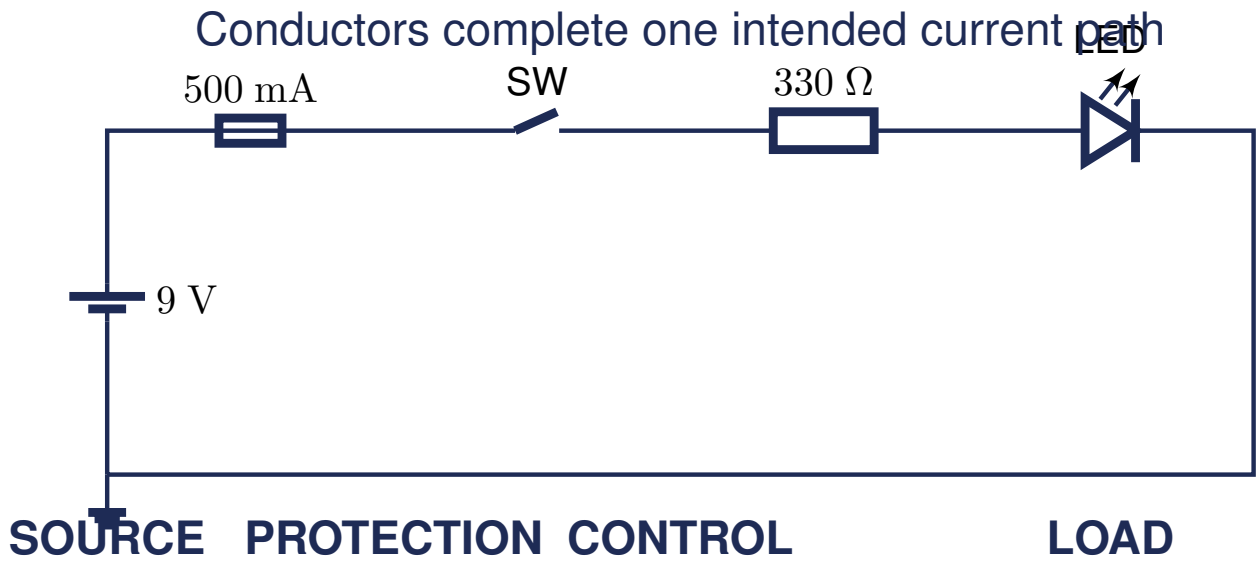


Figure 1: Protected classroom circuit.

Predict and calculate first

Use $V_S = 9.0\ \text{V}$, $V_F = 2.0\ \text{V}$, and $R = 330\ \Omega$.

Quantity	Symbol	Predicted value
LED current	I	
Resistor voltage	V_R	
LED voltage	V_F	
Resistor power	P_R	

Exact calculator entry: _____

Simulate

1. Build the schematic in Tinkercad with the switch open.
2. Confirm values and meter placement before starting the simulation.
3. Close the switch, record readings, and stop the simulation.
4. Explain one difference from your prediction and one simulation limitation.

Physical build and measurement

1. Keep the physical source disconnected and the switch open.
2. Identify the LED polarity, resistor value, fuse rating, and DMM lead jacks.
3. Build source, fuse, switch, resistor, and LED in series.
4. Ask a partner to trace the intended path and complete the pre-power check.
5. Obtain teacher approval.

6. Set a safe current limit, energize, and close the switch.
7. Measure voltage in parallel. De-energize before inserting an ammeter in series.
8. Return the red lead from the current jack when finished.

Quantity	Calculated	Simulated	Measured	Percent difference
LED current				
Resistor voltage				
LED voltage				

Troubleshooting

With the teacher's approval, open the switch or remove one jumper. Predict normal and faulted readings before measuring. Do not introduce a short circuit.

Test point or quantity	Normal prediction	Fault prediction	Measured	Meaning
Source voltage				
Voltage across open				
Total current				

Reflection

1. Which pre-power check prevented the most likely error?
2. What evidence distinguished the fault from a dead source?
3. What did Tinkercad simplify or omit?
4. What would you change before the next build?

Front evidence photo: _____ **Back evidence photo:** _____

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