THE CAPACITOR / CHARGE AND DISCHARGE LAB A3

1. TASK

Why do you need a capacitor? And can a capacitor be used as a current source for an LED?

2. SOLUTION APPROACH

A capacitor is an energy storage. It stores electric charge. If it is connected to an LED when charged the LED will light up for a certain amount of time depending on the amount of power taken.

3. EXPERIMENT DESCRIPTION

Lab A3.1: Use the 10-100uF variable capacitor and set the rotary switch to level 9 (about 100uF). The larger the capacity, the more charge can be stored on the capacitor. If we connect the capacitor directly to the 9V PSITRON battery module, then a charging current flows for a short time. For ceramic capacitors, care must not be taken to ensure correct polarity of the capacitor. The charging current can be limited via a resistor connected in series. Since the charging resistor reduces the charging current it takes longer to fully charge the capacitor. If the capacitor is charged without a resistor then after a few seconds all magnetic wires in the circuit can be removed. The two ends of the capacitor may now no longer be bridged or touched otherwise the capacitor will be discharged again. To illustrate the charging process an LED can be inserted in the circuit. The LED lights up during the charging process.

Lab A3.2: As in the previous experiment, the two contacts of the capacitor may not be bridged. Now connect the capacitor to an LED via a series connected variable resistor. Depending on the value of the variable resistor the LED lights up stronger or weaker. After a certain time the capacitor is discharged again.

4. OBSERVATION AND EXPLANATION

Lab A3.1: If an additional LED has been installed in the circuit then you will see that it lights up brightly when charging the capacitor at the beginning. Its brightness decreases over time. After a few seconds, the LED goes out and no current flows to the capacitor anymore. It is charged. For DC (constant voltage) the charge current follows an exponential charge function.

Lab A3.2: To operate the LED no additional power source is required. The capacitor is charged to a voltage of almost 9V and supplies the LED until it is fully discharged again. If the resistance in the circuit is high, the LED will be lit longer but the LED lights up weaker as the current is limited by the resistor.

5. MATHEMATICAL VIEW

The charge stored in the capacitor can be calculated according to formula F10:

At C = 100uF and U = 9V the charge becomes Q = 100uF * 9V = 0.008 Q (Coulomb) stored in the capacitor.

The time constanct 1τ according to formula F13 is:
τ=100k*100uF=10s

After 10s the capacitor is charged to the voltage of about 9V * 0.63V = 5.7V. (see diagram D10) With the multimeter you can measure the voltage at both contacts of the capacitor.

LEARNING SUCCESS

A capacitor stores charge and when it is fully charged it is an insulator. Current flows during the charging or discharging process. The charging and discharging current varies with time. At the beginning of the charging and discharging process the current is greater than towards the end.

AUTHOR: PSITRON UG

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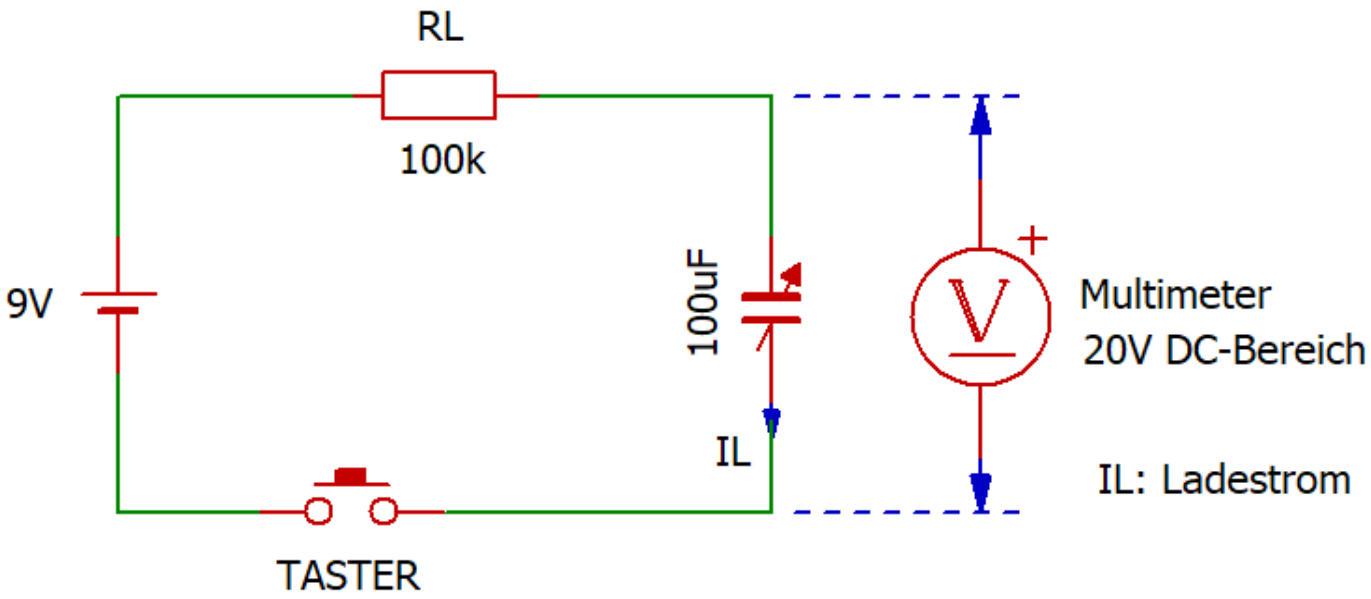
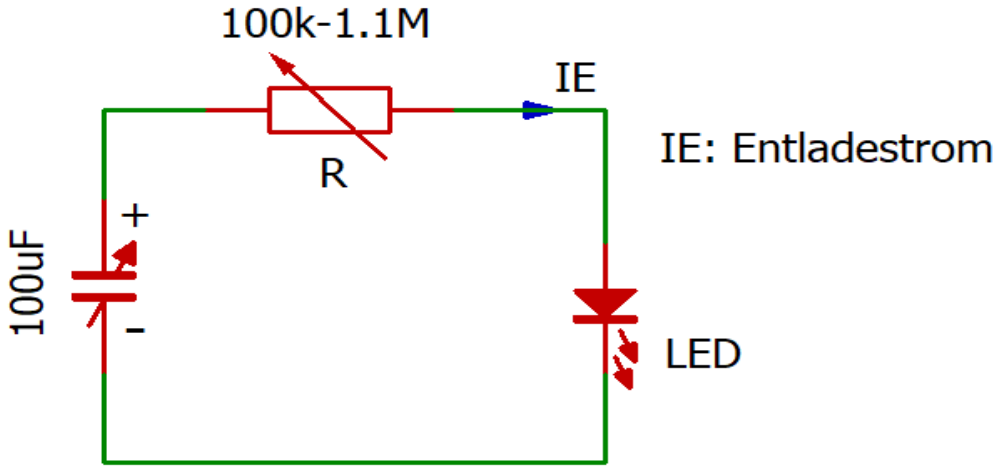


Charge the capacitor



Discharge the capacitor
(Energy source)

AUTHOR: PSITRON UG