

Experiment 8

Transients of a First Order RC Circuit

Introduction

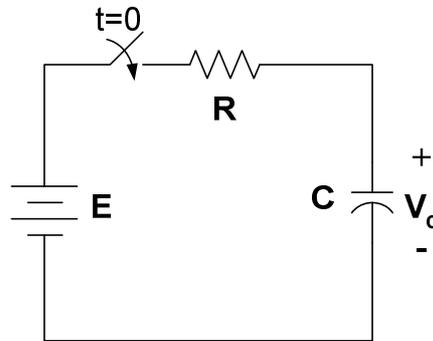


Figure 1: RC series circuit

The capacitor in the circuit of Figure 1 is assumed to have no initial voltage. When the switch is closed, the capacitor begins to charge. The voltage $V_c(t)$ across the capacitor for $t=0$ is given as,

$$V_c(t) = E(1 - e^{-t/RC}) \quad (1)$$

The current through the capacitor is expressed as,

$$I_c = \frac{E}{R} e^{-\frac{t}{RC}} \quad (2)$$

Objectives

1. To perform a transient analysis of the circuit using *Multisim Electronic Workbench*
2. To verify the simulation results with laboratory hardwired components.

Materials

One dc power source
One multimeter
Capacitor, 3.3mF, 80V dc
Resistor, 6.8K Ω
One switch & one stopwatch (for hardwired experiment).

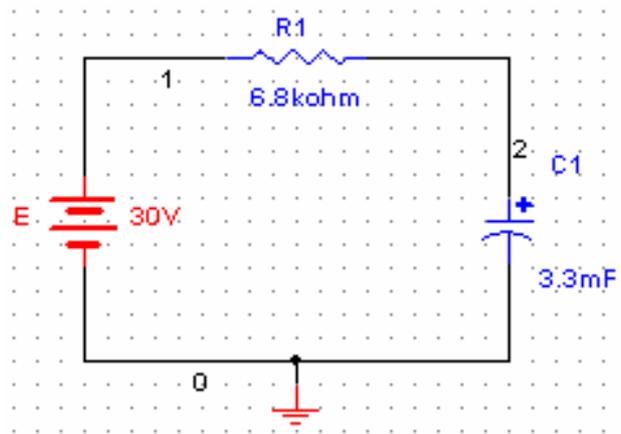


Figure 2: RC circuit for simulation on Multisim Electronics Workbench

Procedure

Simulation

1. Build the circuit on *Multisim Electronics Workbench*. Note the node numbers.
2. Run the Transient Analysis. The procedure is given as:
 - a. Select **Simulate** on **Main Menu**
 - b. Select **Analysis**
 - c. Select **Transient Analysis**
 - d. Select **Analysis Parameters**
 - Initial Conditions → Set to zero
 - Start time 0 s
 - End time 120 s
 - e. Select **Output Variables**
 - select node **2** (left box, this is the node for capacitor voltage, you might have different node number for capacitor voltage)
 - select **plot during simulation** (right box)
 - f. Select **Simulate**
3. Observe the wave shape. If you have access to a printer, print your results. Using the cursor tool record the results and enter the results into Table 1 at the given time instants.

Table 1 Transient response of RC circuit

Time (sec)	0	5	10	15	20	30	40	50	60	70	80	90	100	110	120
V_c (Workbench)															
V_c (Hardwired)															
Average															

- Plot V_c vs. time (in the event you could not get a print).

Hardwired Experiment

- Build the circuit given in Figure 3 with laboratory hardwired components. Note that this circuit is the same as in Figure 2 except the switch.

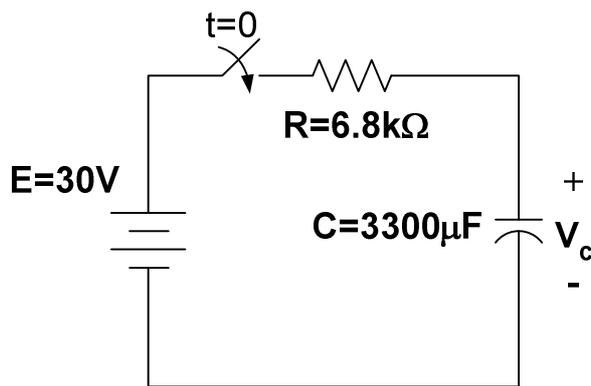


Figure 3: RC circuit for hardware experiment

- Turn switch on and measure the voltage across the capacitor using a multimeter. Keep counts of time using a stopwatch. Follow the time schedule as given in Table1.
- Repeat the measurements three times and find the average for each time steps. Enter the average value in Table 1. Before repeating the measurements, place a short circuit across the capacitor to make sure that capacitor has no voltage initially (Use a small resistance in series to discharge the capacitor)
- Plot the voltage response on the same graph paper as simulation plot.

