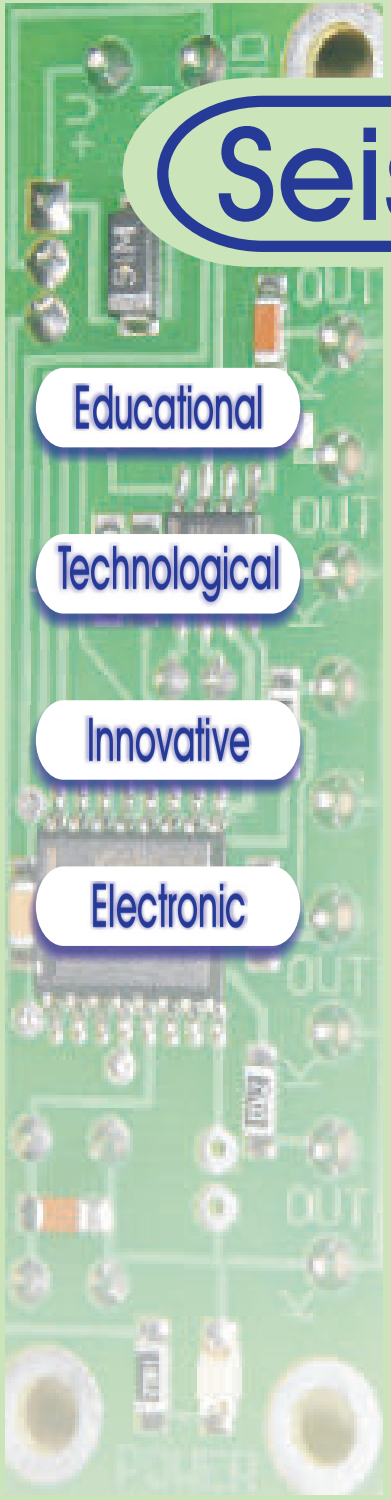

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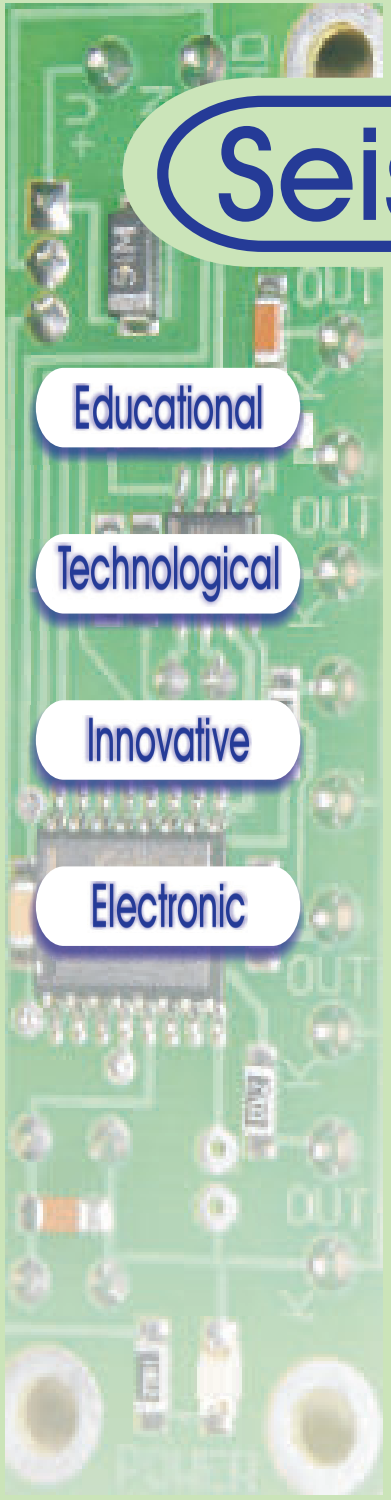
RC CIRCUIT

Resistor Capacitor Circuit



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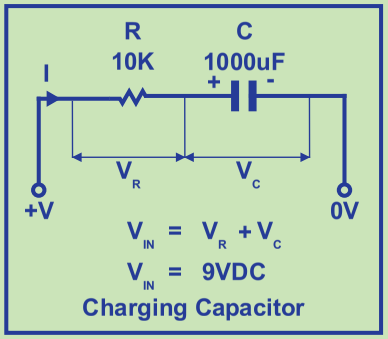
RC CIRCUIT

Charging and discharging of a capacitor through a series resistor

Description	Formula	Diagram
The circuit to the right is named a RC circuit (short for resistor capacitor circuit). Both the resistor and capacitor are in series, forming a timing circuit. The charge and discharge time of a capacitor will be shorter with a lower series resistance value for example 10K, compared to a longer charge and discharge time of a capacitor with a higher series resistance value for example 10M. The time constant is the time needed to increase the voltage across the capacitor from 0 to 63.2% of the supply voltage and may be calculated by multiplying the capacitance and resistance values. The voltage across the capacitor at 63.2% will be 5.68V with a 9V supply. The energy supplied to the capacitor when the voltage is increased from 0V to 9V is 0.0405 Joule.	Time Constant = R x C = 10K x 1000uF = $(10 \times 10^{3}) \times (1000 \times 10^{-6})$ = 10 seconds V_c = 9V x 0.632 = 5.688 V at 63.2% of supply voltage $W_c = 0.5 \times C \times V^2$ = $0.5 \times (1000 \times 10^{-6}) \times 9^2$ = 0.0405 Joule	 $V_{IN} = V_R + V_C$ V_{IN} = 9VDC Charging Capacitor

Resistor Capacitor Circuit

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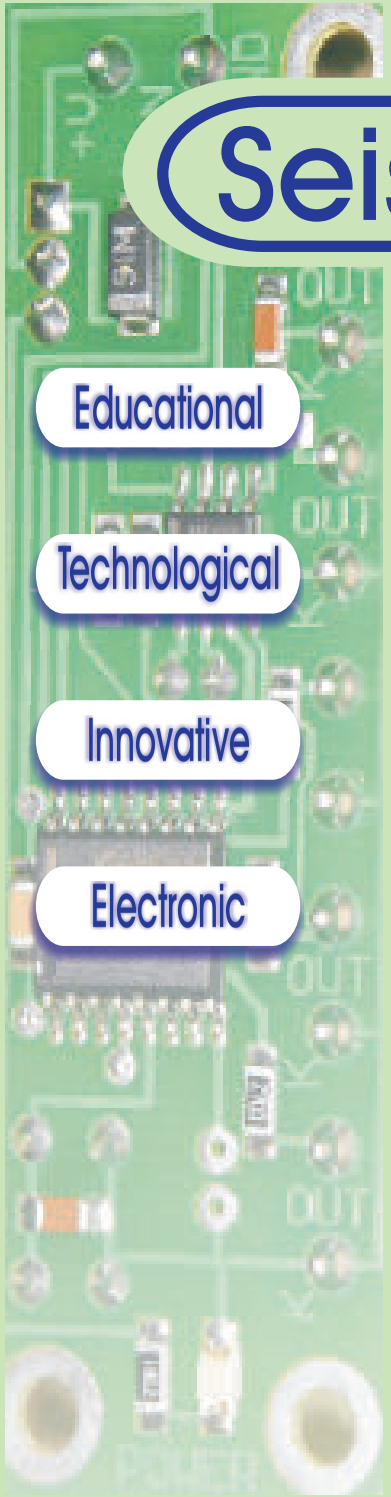

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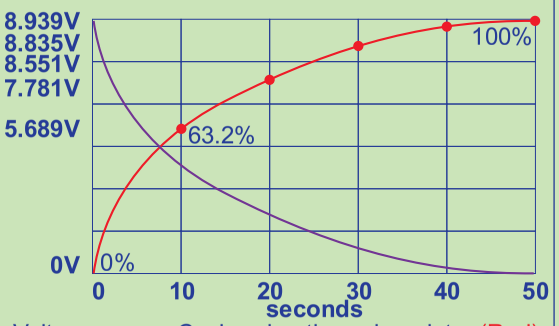
RC CIRCUIT

Charging a capacitor through a series resistor across a DC supply

Description	Formula	Graph
The initial charging current is 0.9mA and is the maximum current that flows in the circuit and decreases to zero. When electrical power is applied, the maximum current is instantly available. The graph depicts that as the voltage over the capacitor increases, the voltage across the resistor decreases. This demonstrate that the sum of the voltage drop across each series component is equal to the input voltage. To calculate the immediate voltage after 20 seconds of charging, make use of the formula to the right. The capacitor will be fully charged in 5 time constants. To calculate the immediate current after 20 seconds of charging, make use of the formula to the right.	**Initial Current Charging** = $\left(\frac{V}{R}\right)$ = $\left(\frac{9}{10 \times 10^{3}}\right)$ = 0.9 mA **Immediate Voltage Charging** = $V(1 - e^{-\frac{t}{T}})$ = $9(1 - e^{-\frac{20}{10}})$ = 7.781 V **Immediate Current Charging** = $I(e^{-\frac{t}{T}})$ = $0.9(e^{-\frac{20}{10}})$ = 0.121 mA	 Voltage across C, charging through resistor (Red) Voltage across R, charging (Purple)

Resistor Capacitor Circuit

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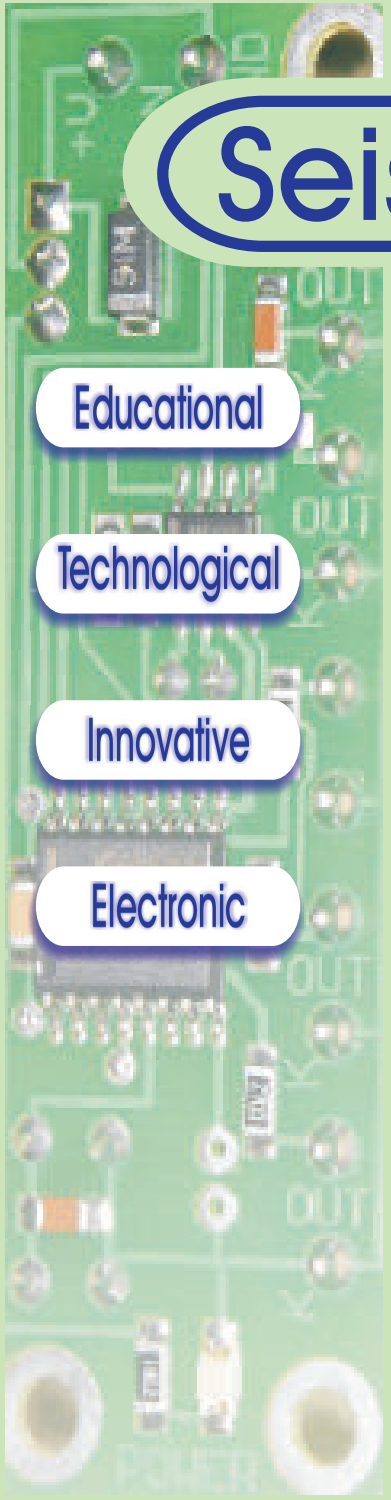

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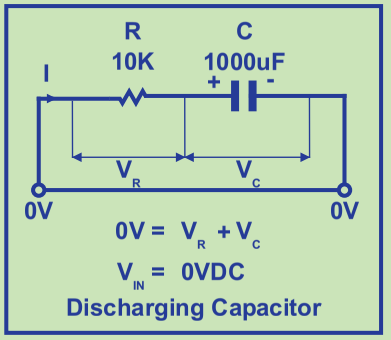
RC CIRCUIT

Discharging a capacitor through a series resistor

Description	Formula	Diagram
To calculate the immediate voltage after 20 seconds of discharging, make use of the formula to the right. The capacitor will be fully discharged in 5 time constants. To calculate the immediate current after 20 seconds of discharging, make use of the formula to the right. When discharging the capacitor, the time constant is the time needed for the voltage across the capacitor to decrease to 36.8% of its fully charged value. The voltage across the capacitor at 36.8% will be 3.312V with a 9V supply.	**Immediate Voltage Discharging** = $V(e^{-\frac{t}{T}})$ = $9(e^{-\frac{20}{10}})$ = 1.218 V **Immediate Current Discharging** = $-I(e^{-\frac{t}{T}})$ = $-0.9(e^{-\frac{20}{10}})$ = -0.121 mA V_c = 9V x 0.368 = 3.312 V at 36.8% of initial voltage across the capacitor	 0V = $V_R + V_C$ V_{IN} = 0VDC Discharging Capacitor

Resistor Capacitor Circuit

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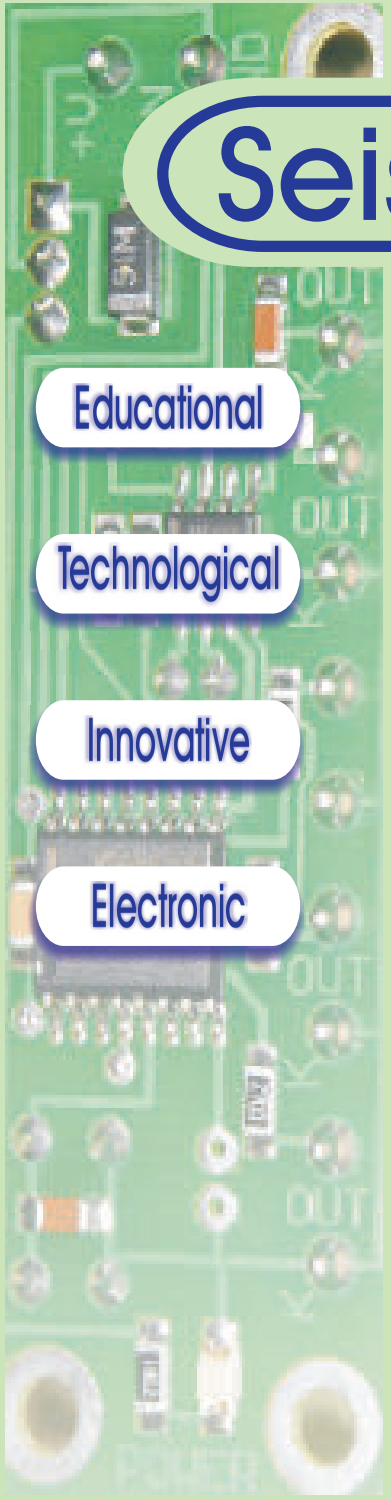

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Resistor Capacitor Circuit

RC CIRCUIT

Discharging a capacitor through a series resistor

Description

The graph to the right show that when discharging the capacitor, the voltage across the capacitor summed with the voltage across the resistor is 0V.

Table

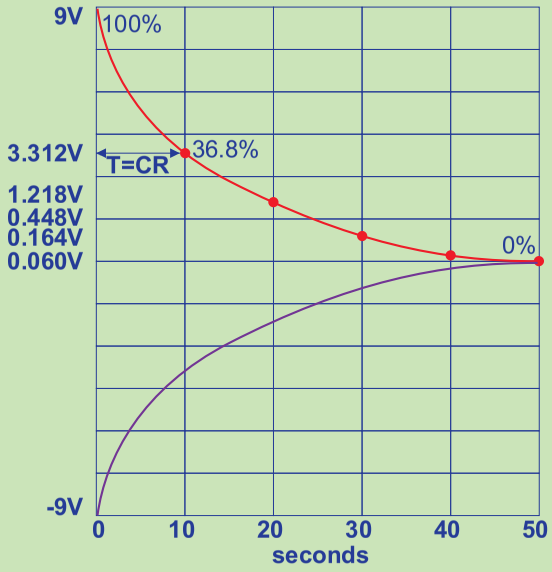
Supply is 9 V
C is 1000 uF
T is 10 seconds

Initial current is 0.9 mA
63.2 % is 5.689 V
36.8 % is 3.312 V

Discharging the capacitor C		
time t	Immediate voltage	Immediate current
10 seconds	3.312 V	-331 mA
20 seconds	1.218 V	-121 mA
30 seconds	0.448 V	-44.8 mA
40 seconds	0.164 V	-16.4 mA
50 seconds	0.060 V	-6 mA

Charging the capacitor C		
time t	Immediate voltage	Immediate current
10 seconds	5.689 V	331 mA
20 seconds	7.781 V	121 mA
30 seconds	8.551 V	44.8 mA
40 seconds	8.835 V	16.4 mA
50 seconds	8.939 V	6 mA

Graph



Voltage across C, discharging through resistor (Red)
Voltage across R, discharging (Purple)

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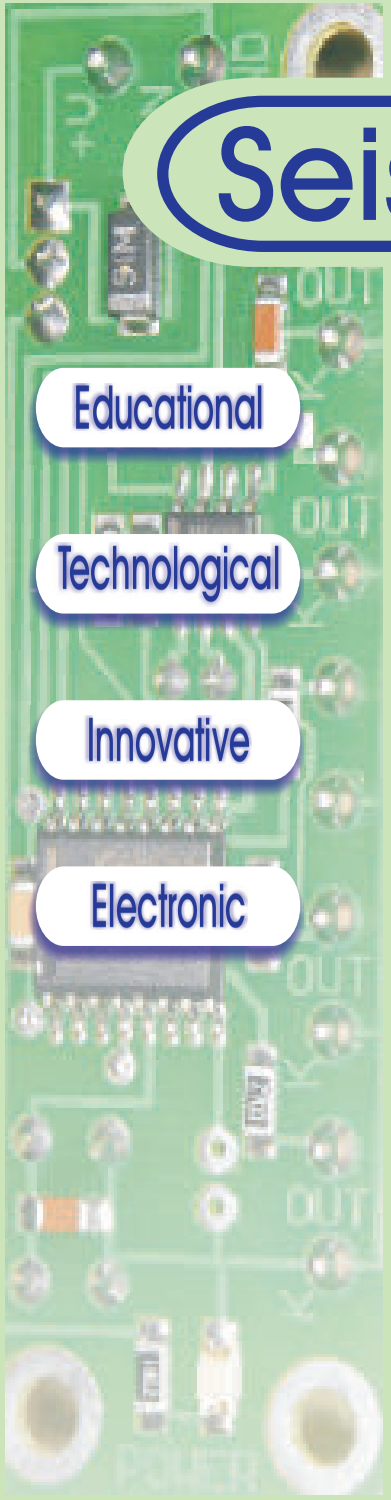

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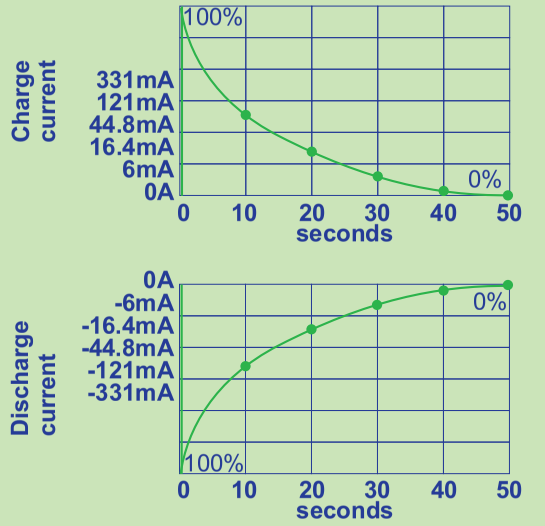
RC CIRCUIT

Charge and discharge current of a capacitor

Description	Formula	Graph
The graph on the right demonstrate graphically the change in current when charging and discharging a capacitor. If the voltage across the capacitor increases the current decreases and if the voltage across the capacitor decreases the current increases. When discharging the capacitor, the immediate current is high and decreases to zero. The current starts at the zero line in the negative direction and decreases back to zero. A capacitor is a device that has the ability to store energy and cannot discharge a larger amount of energy that it was initially charged with. It is important to note that charging a capacitor with a high voltage may be dangerous. It is important to note the polarity of the capacitor leads and the maximum voltage rating of the capacitor.	Intentionally Left Blank	

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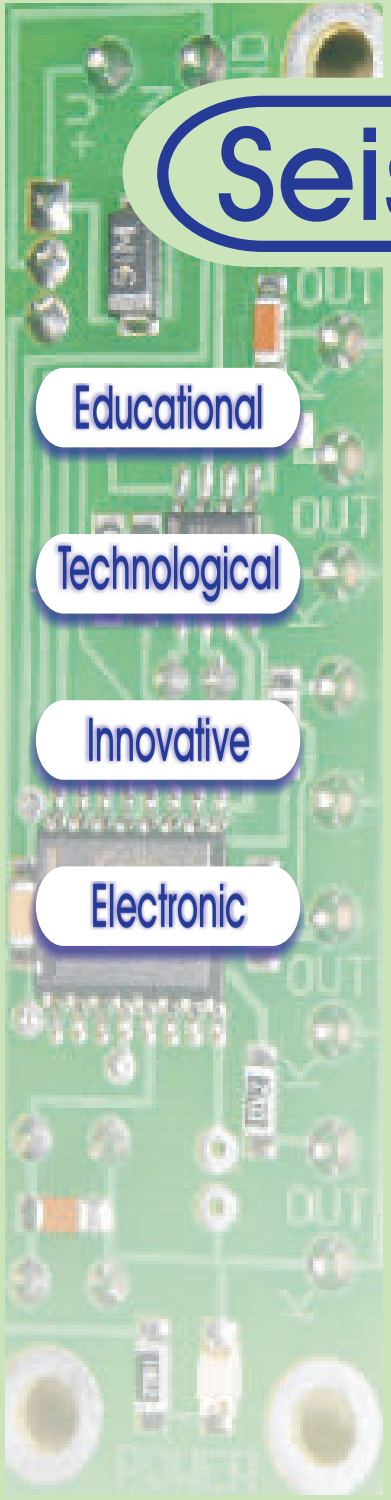

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Contact Details for Seismo-Quake™

Information	
Website	www.seismoquake.com