Capacitors

1

Environmental Engineer?

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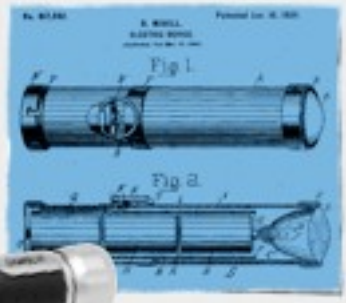
What is inside a flashlight?

Battery?

Bulb?

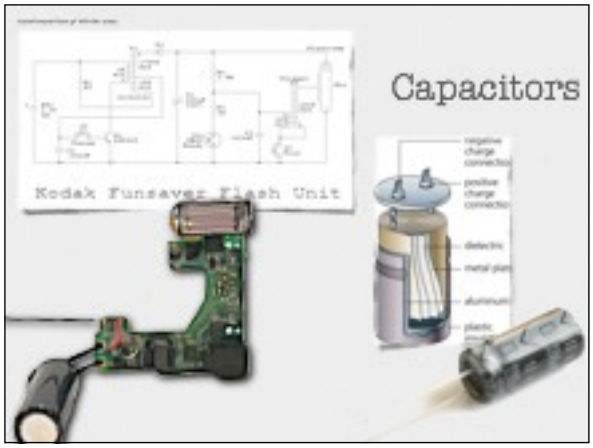
Switch?



3

Why is a camera flash different?

4



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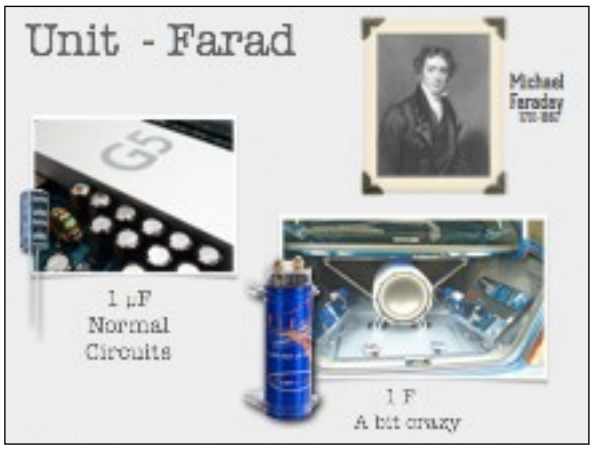

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Capacitance

- C - Capacitance
  - Unit - Farad (F)
- Q - Charge
  - Unit - Coulomb (C)
- V - Potential or Voltage
  - Unit - Volt (V)

$$C = \frac{Q}{V}$$

$$Q = VC$$

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Equations

$$W = \tfrac{1}{2}QV$$

- W - Work or Energy (Joule)
- combinations include:

$$W = \tfrac{1}{2}cv^2 \qquad W = \tfrac{1}{2}\frac{Q^2}{C}$$

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Capacitors in Parallel

There is more room for the charges to be stored, making this a stronger total capacitance.

Voltage: $V_T = V_1 = V_2 = V_3$

Charge: $Q_T = Q_1 + Q_2 + Q_3$

Capacitance: $C_T = C_1 + C_2 + C_3$

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Capacitors in Parallel

	Q (C)	V (V)	C (F)	W (J)
C_1			4	
C_2			6	
C_3			10	
TOTAL		10		

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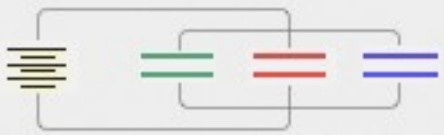
Capacitors in Parallel



	Q (C)	V (V)	C (F)	W (J)
C_1			4	
C_2			6	
C_3			10	
TOTAL		10	20	

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Capacitors in Parallel

	Q (C)	V (V)	C (F)	W (J)
C_1		10	4	
C_2		10	6	
C_3		10	10	
TOTAL		10	20	

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Capacitors in Parallel

	Q (C)	V (V)	C (F)	W (J)
C_1	40	10	4	
C_2	60	10	6	
C_3	100	10	10	
TOTAL	200	10	20	

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Capacitors in Parallel

	Q (C)	V (V)	C (F)	W (J)
C_1	40	10	4	200
C_2	60	10	6	300
C_3	100	10	10	500
TOTAL	200	10	20	1000

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Capacitors in Series

*the source for potential is separated by even more distance, this decreases the charge that can be stored

Voltage: $V_T = V_1 + V_2 + V_3$

Charge $Q_T = Q_1 = Q_2 = Q_3$

Capacitance: $1/C_T = 1/C_1 + 1/C_2 + 1/C_3$

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Capacitors in Series

	Q (C)	V (V)	C (F)	W (J)
C_1			120	
C_2			30	
C_3			24	
TOTAL		100		

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Capacitors in Series

	Q (C)	V (V)	C (F)	W (J)
C_1			120	
C_2			30	
C_3			24	
TOTAL	1200	100	12	

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Capacitors in Series

	Q (C)	V (V)	C (F)	W (J)
C_1	1200		120	
C_2	1200		30	
C_3	1200		24	
TOTAL	1200	100	12	

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Capacitors in Series

	Q (C)	V (V)	C (F)	W (J)
C_1	1200	10	120	
C_2	1200	40	30	
C_3	1200	50	24	
TOTAL	1200	100	12	

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Capacitors in Series

	Q (C)	V (V)	C (F)	W (J)
C_1	1200	10	120	6,000
C_2	1200	40	30	24,000
C_3	1200	50	24	30,000
TOTAL	1200	100	12	60,000

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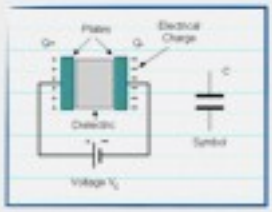
Capacitance

$$C = \frac{k\epsilon_o A}{d}$$



- Capacitance Farad (F)
- Permittivity of Free Space
  - ε_o = 8.854 x 10^{-12} F/m
  - k - Relative permittivity
  - Dielectric
- Area m^2
- Separation m

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