

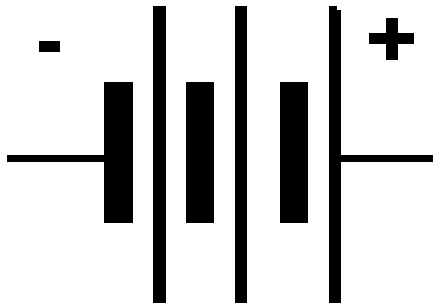
# Meet the Multimeter

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# What's a Voltage Source?

- Symbol: V
- Units: V (volt)
- Diagram:



A voltage source can be a battery, a power cord, a generator, a capacitor, or anything else that creates or stores power.

The voltage measures how much potential energy it gives the electrons flowing out of it.

One electron with one volt has a total energy of  $1\text{eV} = 1.6 \times 10^{-19} \text{ J}$

# What's a Resistor?

- Symbol: R
- Units:  $\Omega$  (ohm)
- Diagram:

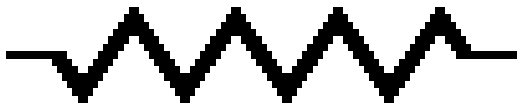
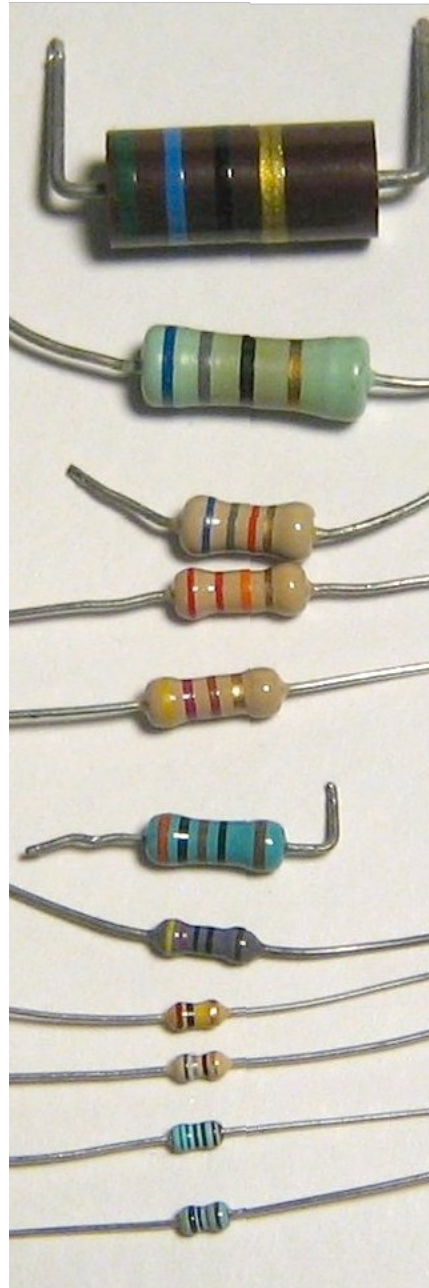
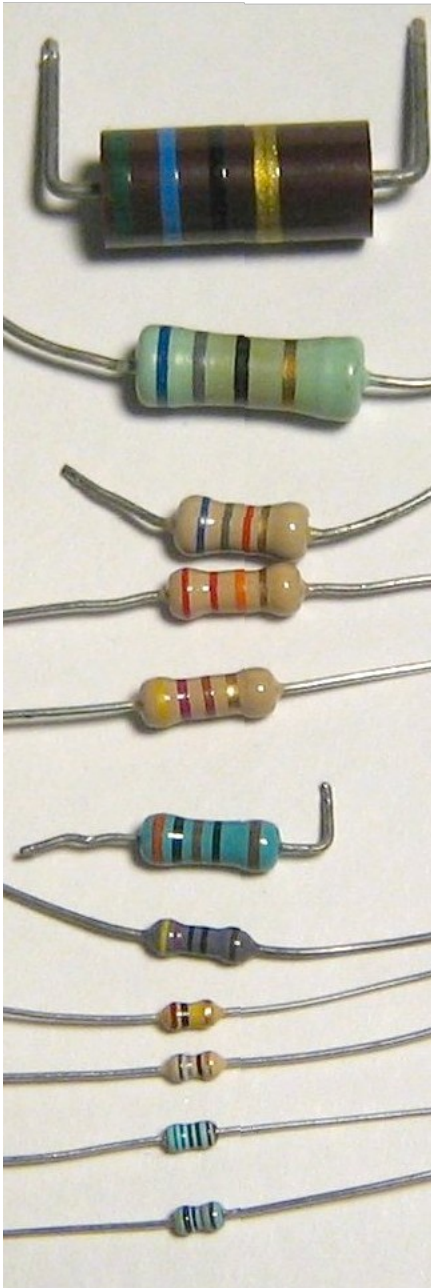


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Resistors impede the flow of current through a circuit, dissipating its power through heat, light, or other work. Many circuit elements have a resistance or can be modeled as one, along with their other functions.

# How To Read a Resistor



Color	Significant figures	Multiplier	Tolerance		Temp. Coefficient (ppm/K)	
Black	0	$\times 10^0$	-		250	U
Brown	1	$\times 10^1$	$\pm 1\%$	F	100	S
Red	2	$\times 10^2$	$\pm 2\%$	G	50	R
Orange	3	$\times 10^3$	-		15	P
Yellow	4	$\times 10^4$	( $\pm 5\%$ )	-	25	Q
Green	5	$\times 10^5$	$\pm 0.5\%$	D	20	Z
Blue	6	$\times 10^6$	$\pm 0.25\%$	C	10	Z
Violet	7	$\times 10^7$	$\pm 0.1\%$	B	5	M
Gray	8	$\times 10^8$	$\pm 0.05\%$ ( $\pm 10\%$ )	A	1	K
White	9	$\times 10^9$	-		-	
Gold	-	$\times 10^{-1}$	$\pm 5\%$	J	-	
Silver	-	$\times 10^{-2}$	$\pm 10\%$	K	-	
None	-	-	$\pm 20\%$	M	-	

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[Resistor color chart](#) from Wikipedia.

# What's a Diode?

- Symbol: D
- Units: n/a
- Diagram:

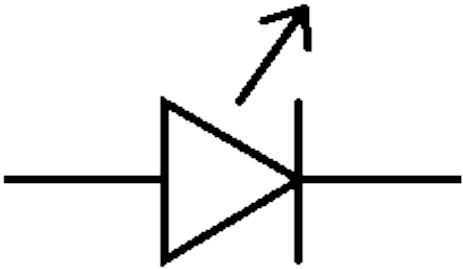
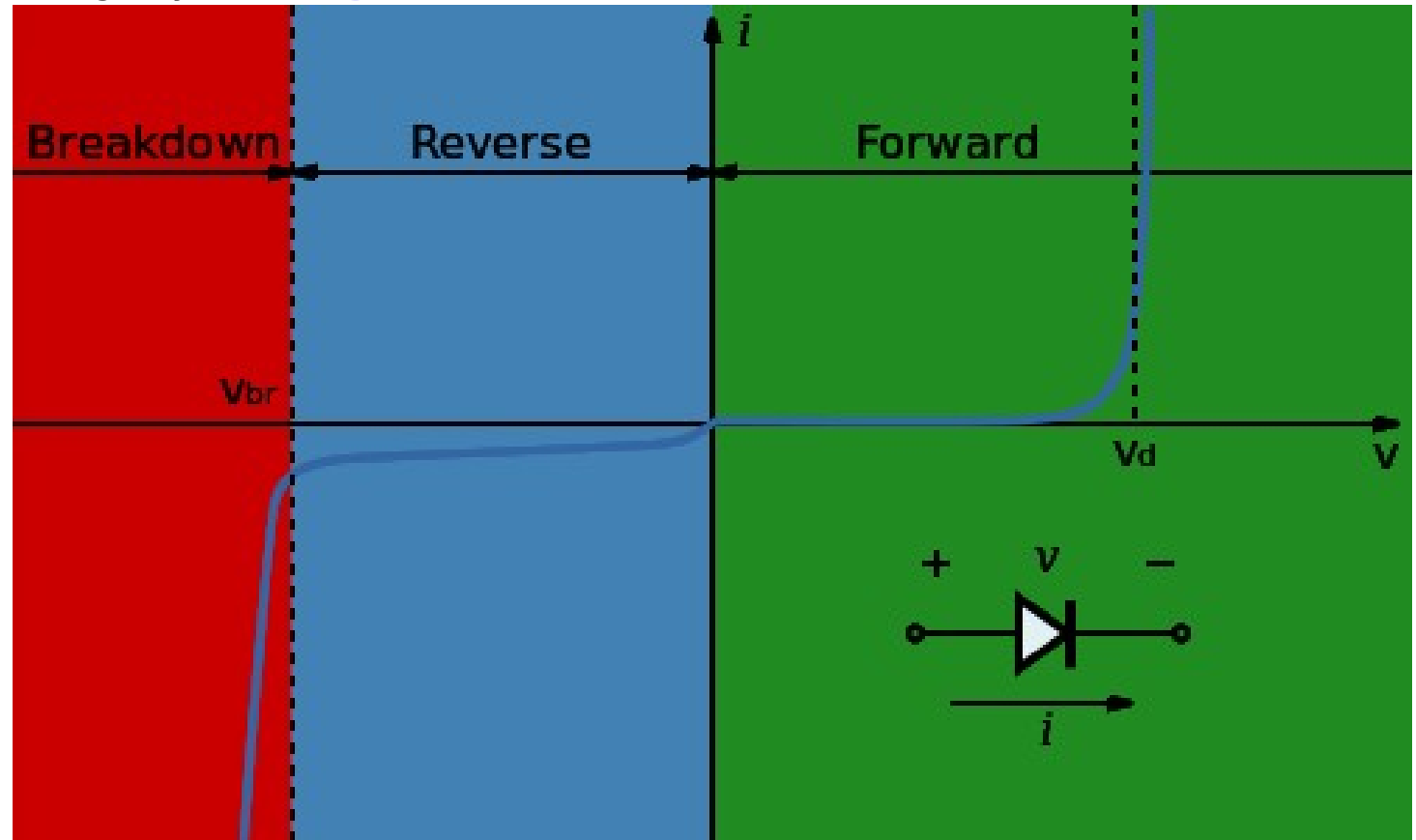


Image by [H1voltage](#) on Wikimedia Commons.



Diodes have a nonlinear relationship between current and voltage, unlike regular resistors. They are also one-directional.

# What's a Capacitor?

- Symbol: C
- Units: F (farad)
- Diagram:

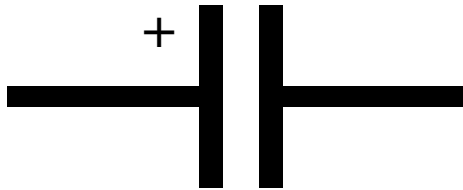


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Capacitors are directional, like diodes. They store charge when attached to a voltage, and act as a voltage source when charged.



# Example #1: Household Wiring



- Have you seen something like this in your home?
- What components can you identify?
- Where do the wires come from, where do they go?
- Why are there different-colored wires?

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## Example #2: Breadboard

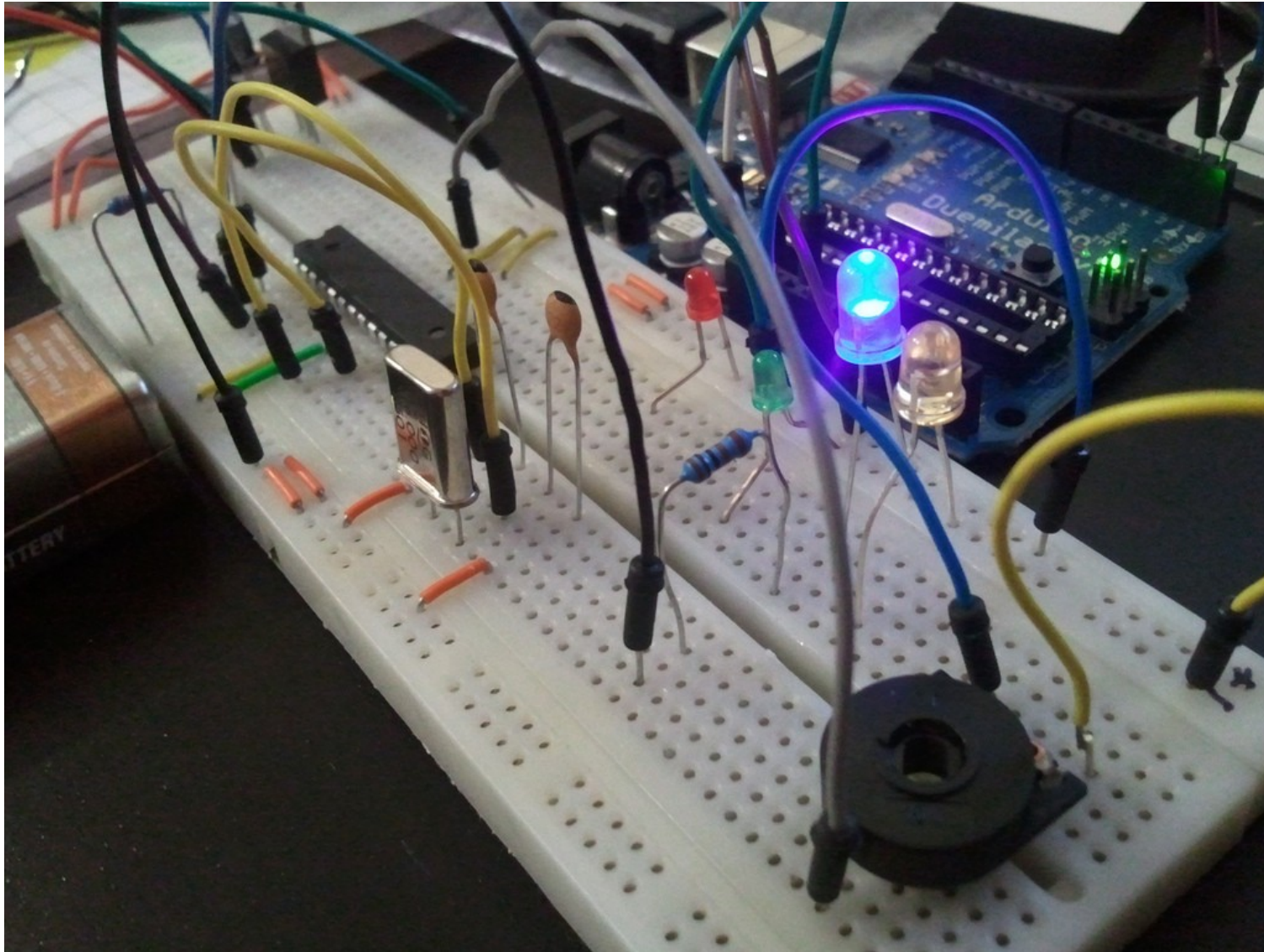


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## Example #3: Perfboard (front)

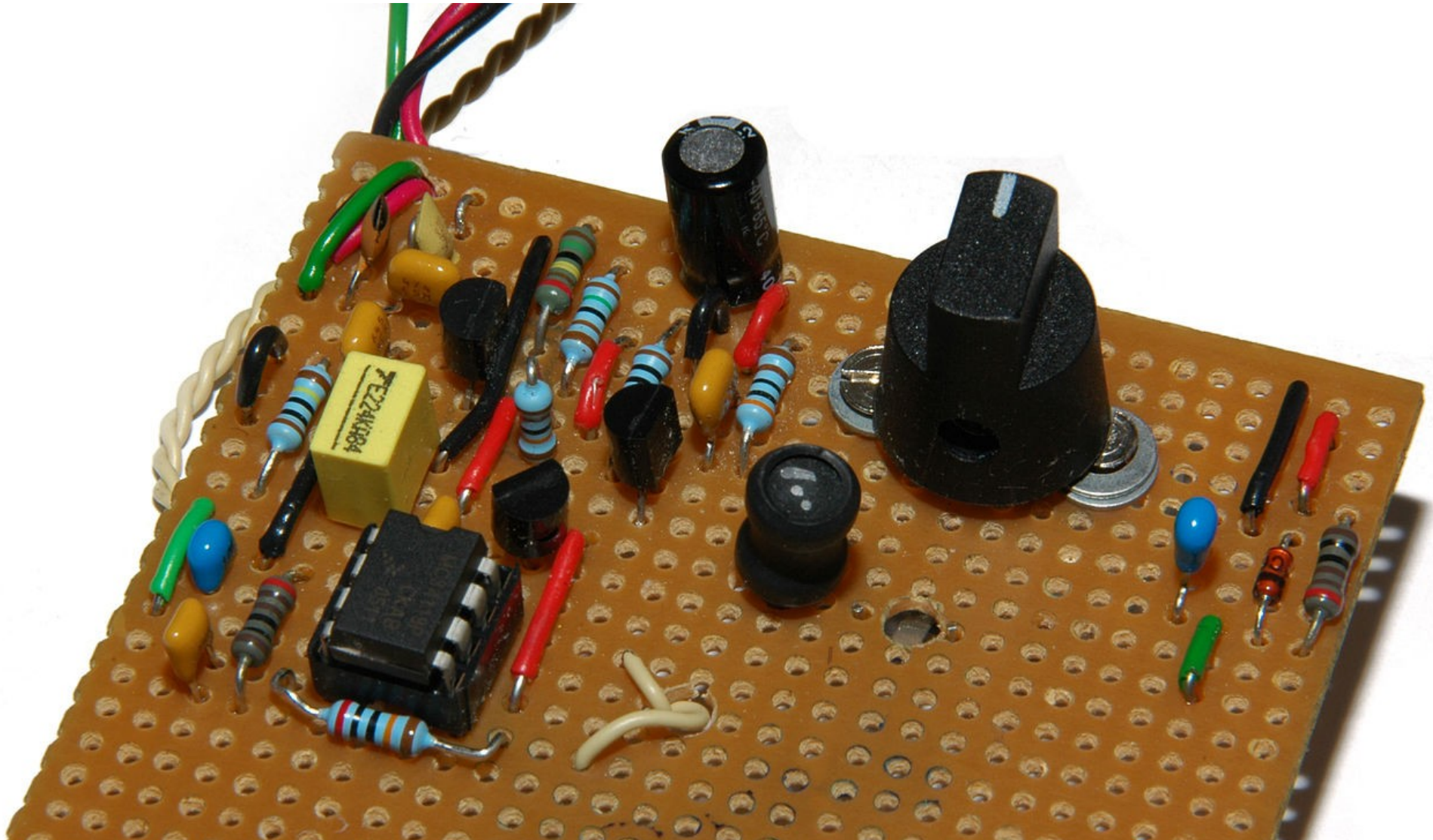


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## Example #4: Surface-Mount (PCB)

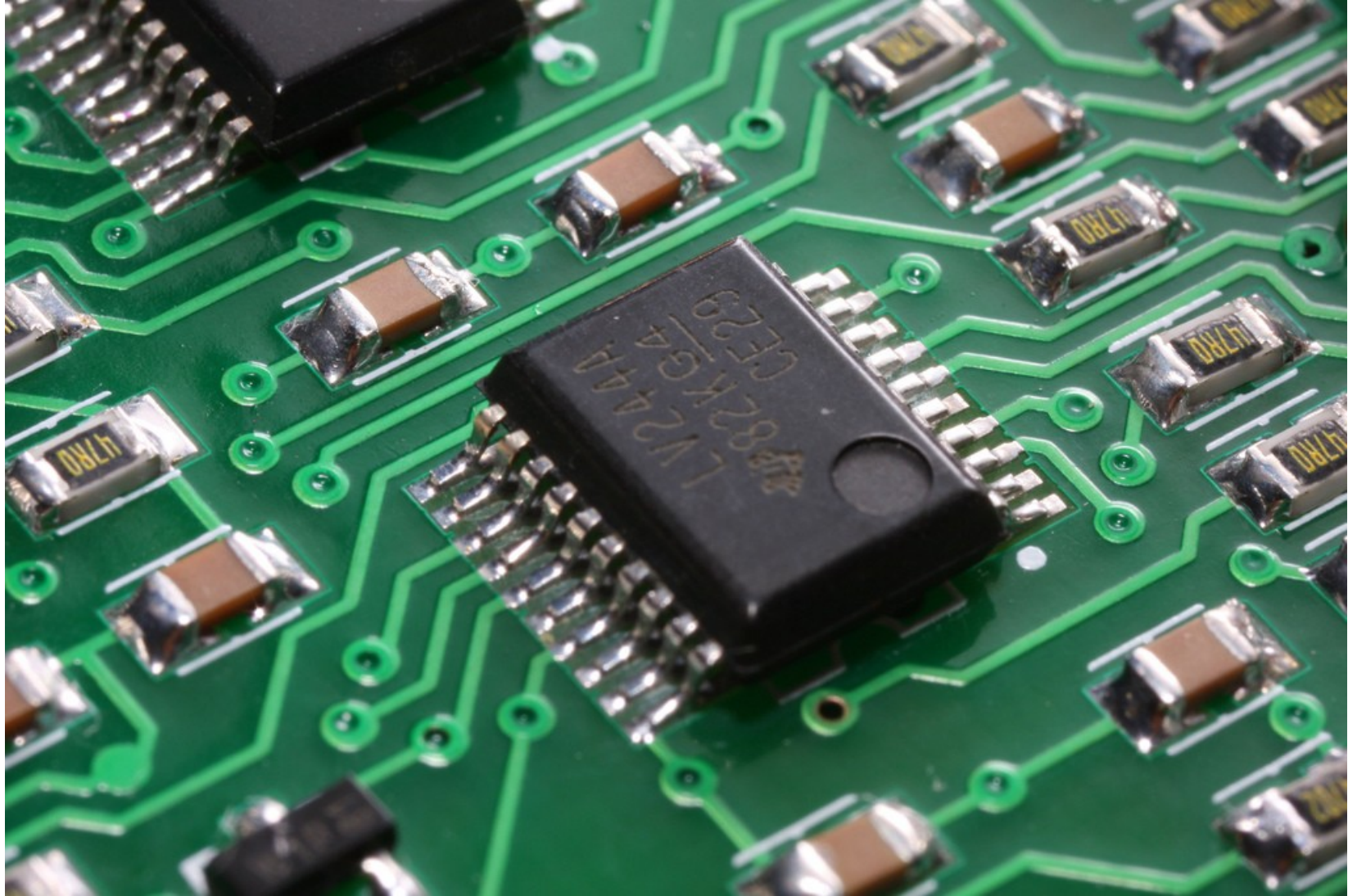


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