

# Real Parts

25A

- Real Resistors, Capacitors, and Inductors have aspects of all three devices
- In many cases, we can ignore the extra components
- In radio circuits we have to account for the non-ideal parts

# Real Resistors

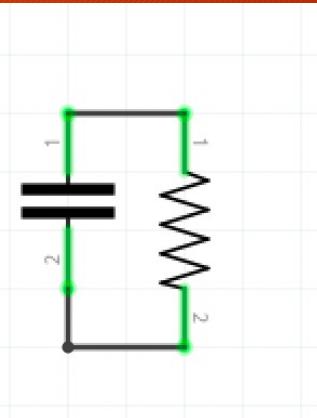
25B

- In most circuits we can ignore the capacitance and inductance of a resistor
- A major exception is in restoring old vacuum tube radios and TVs
- Old resistors were made with carbon and had minimal capacitance and inductance
- Newer resistors are metal film and have inductance and capacitance that can effect radio and TV circuits.
- When restoring old radios/TVs, try to find old parts

# Real Capacitors

25C

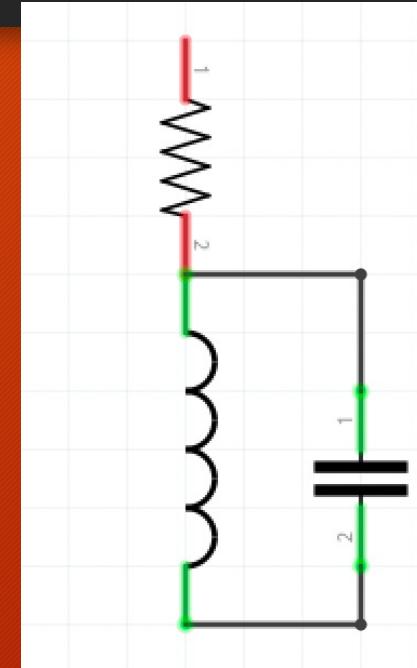
- Real capacitors have some parallel resistance
- In most cases it can be ignored
- Electrolytic capacitors and paper capacitors often have significant parallel resistance, especially when they get old
- That's why they are commonly replaced in restoring old radios and TVs



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# Real Inductors

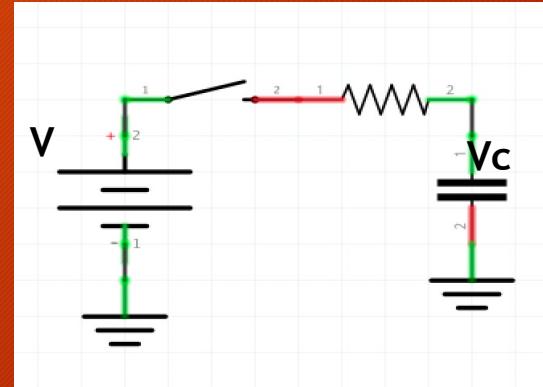
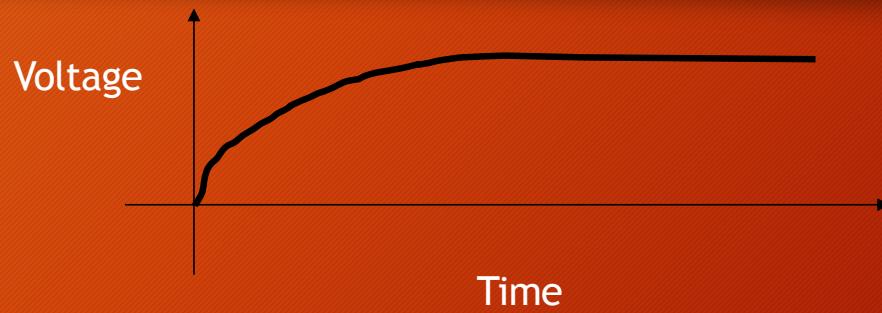
- Real Inductors have series resistance from the wire and capacitance from the wires being close to each other
- When inductors are used in power supplies, the capacitance can be ignored but the series resistance causes a voltage drop across the inductor and heats up the inductor.
- Thus, you will see a power rating on inductors for power supplies
- In radio circuits, both resistance and capacitance affects the circuit design



# Capacitors in DC circuits

25E

- When a DC circuit with a resistor and capacitor is closed, the voltage on the capacitor will slowly increase until it reaches the voltage of the DC source

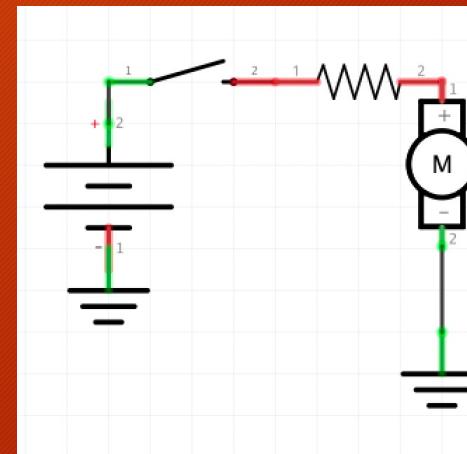
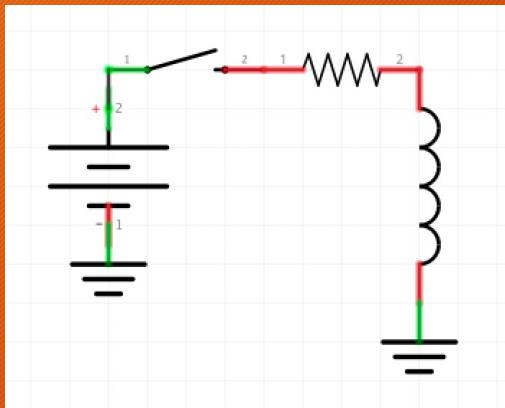


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# Inductors in DC circuits

25F

- When a DC circuit with a resistor and inductor is closed, the current will be very high and limited by the internal resistance of the inductor
- When a motor is started, the starting current is limited by the internal resistance of the motor and can be very high
  - As the motor starts moving, it also works as a generator and creates a voltage that lowers the running current (this is called back emf).



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# Capacitors and Inductors in AC Circuits

26A

- In AC circuits, things get more complex
- The combination of resistors, capacitors, inductors, and the non-ideal nature of them can be used to create all kinds of effects:
  - Low Pass Filters: that reduce the output as the frequency increases
  - High Pass Filters: that increase the output as the frequency increases
  - Tuned circuits: that only pass a small range of frequencies
- The equations to design these circuits can be complicated and use the math of imaginary/complex numbers
- A brief discussion is on the following slide
- Fortunately there are websites that do the calculations for you
- <https://markimicrowave.com/technical-resources/tools/lc-filter-design-tool/>