Impedance

The primary passive components in DC circuits are resistors, inductors, and capacitors. Resistors limit current flow, while inductors and capacitors serve as energy storage devices. Resistors convert excess power into heat, ensuring LEDs operate at the correct nominal current unless shorted. Inductors resist changes in current, while capacitors resist changes in voltage, contributing to a smooth output voltage from power supplies.
Impedance extends the concept of resistance to AC circuits where inductors and capacitors play significant roles.

Inductive reactance increases with frequency according to the formula (2\pi fL), where (f) is frequency and (L) is inductance.
Replacing the inductor with a capacitor (1 microfarad), another phase shift of around 90 degrees occurs but this time the current leads the voltage.
The observed RMS current is 110 milliamps; this introduces capacitive reactance influenced by charge reversal within the capacitor.

Unlike inductors or capacitors, resistors do not create phase shifts; their resistance remains constant regardless of AC frequency.
To calculate total impedance when combining resistive and reactive components (e.g., a 50-ohm resistor with a capacitor), one must use complex impedance rather than simple addition of values.
Impedance can be represented in polar form or Cartesian form. The imaginary unit 'j' represents reactance on the complex plane.