

WHAT ARE SAFETY CAPACITORS?



Safety capacitors are passive electronic components designed to mitigate the effects of transient voltages and interference in electrical circuits. Safety capacitors are designed to help safeguard users and equipment from electrical hazards, even in the event of failure. Since these components are commonly used in AC line filtering and power supply circuits where failure could lead to electric shock, fire, or equipment damage, safety capacitors are subject to stringent testing and certification requirements.

The Role of the Safety Capacitor

In a circuit, safety capacitors used on AC lines filter high-frequency [electromagnetic interference](#) (EMI), or undesirable electromagnetic emissions or disturbances generated either by electronic devices or natural sources in the environment that can interfere with the proper functioning of other nearby devices or systems. This is known as EMI filtering, with the filter providing a safe path for noise while maintaining electrical isolation and safety.

When placed in combination with a series of inductors or resistors, safety capacitors form low-pass filters that attenuate the high-frequency signals (EMI) and allow the lower-frequency power signals to pass (Figure 1). This is the classic EMI filter setup—attenuating unwanted noise above a cutoff frequency. As more electronic devices enter the market, EMI filtering becomes even more crucial as there is an increased likelihood that EMI could cause a device to malfunction, crash, or fail.

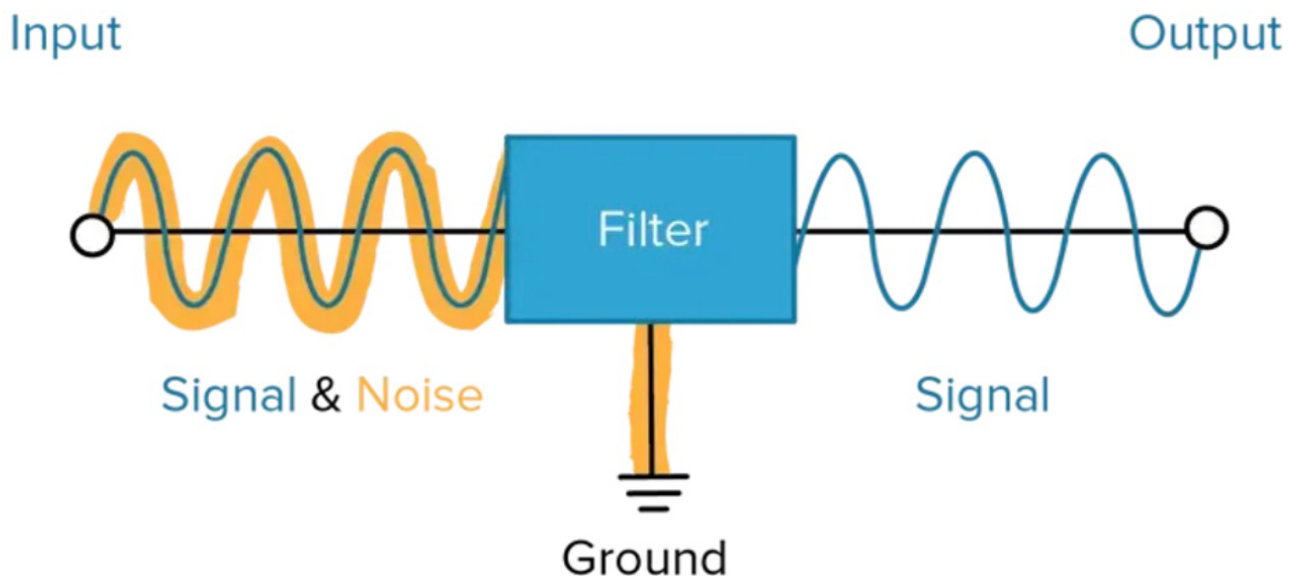


Figure 1. An illustration of how safety capacitors form low-pass filters that attenuate the high-frequency signals (EMI) and allow the lower-frequency power signals to pass.

In power electronics specifically, EMI filters take the form of power line filters that protect the line from upstream noise. While this list may differ depending on system requirements, the core components of a power line filter include:

- A common-mode filter circuit with two or more line-to-chassis capacitors and a common-mode inductor
- A differential mode (DM) filter circuit with at least one pair of series inductors and one line-to-line capacitor
- Compensation networks to adjust the filter's quality (Q) factor and adapt the output impedance as needed
- Transient voltage suppression device(s) to defend against surges

Figure 2 shows an EMI filter structure that could be useful for single-phase AC applications or for DC power inputs.

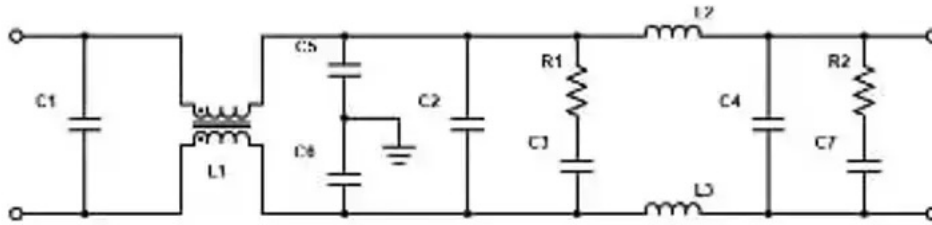


Figure 2: EMI filter structure designed for single-phase AC applications or DC power inputs.

Where Safety Capacitors Are Used

To ensure safe operations and compliance with electrical safety standards, you'll find safety capacitors in nearly every electronic device developed today – from industrial motor drives and HVAC systems to consumer appliances to medical devices, telecommunications equipment, and automotive electronics. For many of these applications, safety capacitors are crucial components that ensure user safety and reliable performance.

Learn more about safety capacitors in general by downloading [The Electrical Engineer's Guide to Safety Capacitors ebook](#), or dive into product details by exploring [our extensive line of safety capacitors](#).

Learn More

If you need help selecting from our portfolio please [contact us](#) and we can guide you through the selection process.



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