

Chapter 14 Capacitors In Ac And Dc Circuits

Rectifier

stages of capacitors and diodes are cascaded to amplify a low AC voltage to a high DC voltage. These circuits are capable of producing a DC output voltage

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

The process is known as rectification, since it "straightens" the direction of current. Physically, rectifiers take a number of forms, including vacuum tube diodes, wet chemical cells, mercury-arc valves, stacks of copper and selenium oxide plates, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motor-generator sets have been used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal...

Capacitor

plastic film capacitors are used extensively in suppression circuits, motor start circuits, and power-factor correction circuits. Ceramic capacitors are generally

In electrical engineering, a capacitor is a device that stores electrical energy by accumulating electric charges on two closely spaced surfaces that are insulated from each other. The capacitor was originally known as the condenser, a term still encountered in a few compound names, such as the condenser microphone. It is a passive electronic component with two terminals.

The utility of a capacitor depends on its capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed specifically to add capacitance to some part of the circuit.

The physical form and construction of practical capacitors vary widely and many types of capacitor are in common use. Most capacitors contain at least two electrical conductors, often...

Electrolytic capacitor

film capacitors, and so can have large capacitance values. There are three families of electrolytic capacitor: aluminium electrolytic capacitors, tantalum

An electrolytic capacitor is a polarized capacitor whose anode or positive plate is made of a metal that forms an insulating oxide layer through anodization. This oxide layer acts as the dielectric of the capacitor. A solid, liquid, or gel electrolyte covers the surface of this oxide layer, serving as the cathode or negative plate of the capacitor. Because of their very thin dielectric oxide layer and enlarged anode surface, electrolytic capacitors have a much higher capacitance-voltage (CV) product per unit volume than ceramic capacitors or film capacitors, and so can have large capacitance values. There are three families of electrolytic capacitor: aluminium electrolytic capacitors, tantalum electrolytic capacitors, and niobium electrolytic capacitors.

The large capacitance of electrolytic...

Aluminum electrolytic capacitor

Aluminium electrolytic capacitors are (usually) polarized electrolytic capacitors whose anode electrode (+) is made of a pure aluminium foil with an etched

Aluminium electrolytic capacitors are (usually) polarized electrolytic capacitors whose anode electrode (+) is made of a pure aluminium foil with an etched surface. The aluminum forms a very thin insulating layer of aluminium oxide by anodization that acts as the dielectric of the capacitor. A non-solid electrolyte covers the rough surface of the oxide layer, serving in principle as the second electrode (cathode) (-) of the capacitor. A second aluminum foil called "cathode foil" contacts the electrolyte and serves as the electrical connection to the negative terminal of the capacitor.

Aluminium electrolytic capacitors are divided into three subfamilies by electrolyte type:

non-solid (liquid, wet) aluminium electrolytic capacitors,

solid manganese dioxide aluminium electrolytic capacitors,...

DC-to-DC converter

also simple capacitive voltage doubler and Dickson multiplier circuits using diodes and capacitors to multiply a DC voltage by an integer value, typically

A DC-to-DC converter is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another. It is a type of electric power converter. Power levels range from very low (small batteries) to very high (high-voltage power transmission).

Ceramic capacitor

Ceramic capacitors are divided into two application classes: Class 1 ceramic capacitors offer high stability and low losses for resonant circuit applications

A ceramic capacitor is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. The composition of the ceramic material defines the electrical behavior and therefore applications. Ceramic capacitors are divided into two application classes:

Class 1 ceramic capacitors offer high stability and low losses for resonant circuit applications.

Class 2 ceramic capacitors offer high volumetric efficiency for buffer, by-pass, and coupling applications.

Ceramic capacitors, especially multilayer ceramic capacitors (MLCCs), are the most produced and used capacitors in electronic equipment that incorporate approximately one trillion (10^{12}) pieces per year.

Ceramic capacitors of special...

High-voltage direct current

levels in alternating current (AC) transmission circuits, but cannot pass DC current. Transformers made AC voltage changes practical, and AC generators

A high-voltage direct current (HVDC) electric power transmission system uses direct current (DC) for electric power transmission, in contrast with the more common alternating current (AC) transmission systems. Most HVDC links use voltages between 100 kV and 800 kV.

HVDC lines are commonly used for long-distance power transmission, since they require fewer conductors and incur less power loss than equivalent AC lines. HVDC also allows power transmission between AC transmission systems that are not synchronized. Since the power flow through an HVDC link can be controlled independently of the phase angle between source and load, it can stabilize a network against disturbances due to rapid changes in power. HVDC also allows the transfer of power between grid systems running at different frequencies...

Electric power system

consumed) and can be supplied from the generators, however it is often more economical to supply such power from capacitors (see "Capacitors and reactors";

An electric power system is a network of electrical components deployed to supply, transfer, and use electric power. An example of a power system is the electrical grid that provides power to homes and industries within an extended area. The electrical grid can be broadly divided into the generators that supply the power, the transmission system that carries the power from the generating centers to the load centers, and the distribution system that feeds the power to nearby homes and industries.

Smaller power systems are also found in industry, hospitals, commercial buildings, and homes. A single line diagram helps to represent this whole system. The majority of these systems rely upon three-phase AC power—the standard for large-scale power transmission and distribution across the modern world...

Network analyzer (AC power)

Some systems used 10 kHz, using capacitors and inductors similar to those used in radio electronics. Model circuits were energized at relatively low

From 1929 to the late 1960s, large alternating current power systems were modelled and studied on AC network analyzers (also called alternating current network calculators or AC calculating boards) or transient network analyzers. These special-purpose analog computers were an outgrowth of the DC calculating boards used in the very earliest power system analysis. By the middle of the 1950s, fifty network analyzers were in operation. AC network analyzers were much used for power-flow studies, short circuit calculations, and system stability studies, but were ultimately replaced by numerical solutions running on digital computers. While the analyzers could provide real-time simulation of events, with no concerns about numeric stability of algorithms, the analyzers were costly, inflexible, and...

Variable-frequency drive

medium-voltage AC-AC and DC-AC topologies. Pulse-width modulation (PWM) variable-frequency drive projects started in the 1960s at Strömberg in Finland. Martti

A variable-frequency drive (VFD, or adjustable-frequency drive, adjustable-speed drive, variable-speed drive, AC drive, micro drive, inverter drive, variable voltage variable frequency drive, or drive) is a type of AC motor drive (system incorporating a motor) that controls speed and torque by varying the frequency of the input electricity. Depending on its topology, it controls the associated voltage or current variation.

VFDs are used in applications ranging from small appliances to large compressors. Systems using VFDs can be more efficient than hydraulic systems, such as in systems with pumps and damper control for fans.

Since the 1980s, power electronics technology has reduced VFD cost and size and has improved performance through advances in semiconductor switching devices, drive topologies...

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