



## GLOSSARY FOR POWER

**AC:** (Alternating Current) Voltage or current which is periodically changing polarity

**AC-DC Converter:** Converts an alternating current power supply eg: 230V mains into one or several DC voltages as required by particular electronic circuits or in APC's case mainly for the charging of battery operated equipment.

**Ambient temperature:** The still-air temperature of the immediate environment measured a minimum of 100mm from the power supply

**Amps:** (Amperes) Unit of measurement of electromotive current (A).

**Basic Insulation:** According to international safety standards (eg UL1950, EN60950) basic insulation provides basic protection against electric shock. In contrast, operational insulation is needed for the correct operation of the equipment, but does not protect against electric shock. Quite frequently, safety standards call for basic insulation between secondary circuits.

**Breakdown voltage:** See: Isolation

**Bridge:** Rectifier circuit incorporating four diodes (full-bridge) or two diodes (half-bridge). Converter or chopper section of switching power supplies incorporating four transistors (full-bridge) or two transistors (half-bridge).

**Brownout:** Condition during peak usage periods when electric utilities reduce their nominal line voltage by 10% to 15%.

**Brownout protection:** The ability of a power supply to continue operating within specification through the duration of a brownout.

bThe period directly following the very first turn-on of a given power supply. It is characterized by a relatively high and declining failure rate.

**Bus:** The system of conductors (wire, cable, copper bars, etc.) used to transport power from the power supply to the load. A communications structure used to control various instruments and subsystems.

**Busbar:** A low impedance conductor which feeds power to various circuits in, for example, an equipment room or within an equipment rack. In the telecommunications industry the busbar voltage is often at a standardised 48V, requiring dc-dc converters to convert the busbar voltage to such voltages as are used by the electronics circuits it is supplying

**CB-report:** Document necessary for the mutual recognition of approvals between different national test norms.



**CEE** (International Commission on Rules for the Approval of Electrical Equipment): A regional, European safety agency. NB: the United States participates only as an observer.  
**Common-mode noise:** The components of noise which is common to both the DC output and return lines with respect to input ground  
**Constant current:** A power supply that regulates current level regardless of changes in load resistance.

**Constant current limiting circuit:** Current-limiting circuit that holds output current at some maximum value whenever an overload of any magnitude is experienced.

**Constant voltage:** A power supply that regulates voltage level regardless of changes in load resistance.

**Convection:** The transference of thermal energy in a gas or liquid by currents resulting from unequal temperatures.

**Convection-cooled** power supply is a PSU that is cooled from the natural motion of an air over the surfaces of its components.

**Crowbar:** A type of overvoltage protection circuit which rapidly places a low resistance shunt across the power supply output terminals if a predetermined voltage is exceeded.

**CSA** (Canadian Standards Association): An independent Canadian organization testing for public safety, similar to the function of Underwriters' Laboratories in the United States.

**Current:** Rate of transfer of electrical charge measured in amperes (A)

**Current limiting circuit:** A circuit designed to prevent overload of a constant-voltage power supply. It can take the form of constant, foldback or cycle-by-cycle current limiting.

**Cycle-by-cycle current limiting circuit:** Current-limiting circuit that immediately reduces output current to some minimum level whenever an overloaded of any magnitude is experienced.

**DC:** Direct Current or unidirectional voltage or current

**Derating:** The specified reduction in an operating parameter to improve reliability. Compensates for a change in one or more other parameters. In power supplies, the output power rating is generally reduced at elevated temperatures.

**Differential mode noise:** That component of noise measured between the DC and output return. It does not include common-mode noise.

**DPA (Distributed Power Architecture):** A system where the supply power is fed to each electronic unit on a busbar and then locally converted at rack or PCB level to such voltages as the electronic circuits require.

**Drift:** See: Stability.

**Dynamic load:** A load that rapidly changes from one level to another. To be properly specified both the total change and the rate of change must be stated.

**Efficiency:** The ratio of total output power to total input power, expressed as a percentage, under specified conditions.

**EMC (Electromagnetic compatibility):** Any electromagnetic effect: Emissions from elements within apparatus (motors, converters, choppers), disturbance of elements and measures for improving the functionality.

**EMI (electromagnetic interference):** Also called radio-frequency interference (RFI), EMI is unwanted high frequency energy caused by the switching transistors, output rectifiers, and zener diodes in switching power supplies. EMI can be conducted through the input or output lines or radiated through space.

**ESR (Equivalent Series Resistance):** The amount of resistance in series with an ideal (lossless) capacitor, which duplicates the performance of a real capacitor. In general, the lower the ESR, the higher the quality of the capacitor and the more effective it is as a filtering device. ESR is a prime determinant of ripple in switching power supplies.

**ETSI (European Telecommunications Standards Institute):** Non-profit making organisation whose mission is to determine and produce the telecommunications standards that will be used for decades to come.

**Faraday shield:** An electrostatic shield wound on a transformer, designed to reduce interwinding capacitance. The result is less common- and differential-mode noise at the output of the power supply.

**FCC (Federal Communications Commission):** United States federal regulating body whose new EMI limitations are affecting the design and production of digital electronics systems and their related subassemblies, such as power supplies.

**Ferroresonance:** The principle used open-loop (non-feedback) voltage stabilizing power supply.

**Filter:** A frequency-sensitive network that attenuates unwanted noise and ripple components of a rectified output.

**Flyback converter:** Switching power supply configuration using a single transistor and a flyback diode.

**Foldback current limiting circuit:** Current-limiting circuit that gradually decreases the output current under overload conditions until some minimum current level is reached under a direct short circuit.

**Forward converter:** Switching power supply configuration using a single transistor.

**Frequency changer:** Power-conversion equipment that transforms AC electric power from one frequency to another without affecting its other characteristics.

**Full Brick:** An industry standard size and pin-out for DC-DC Converters. The package size is 2.50" x 4.8" with the pins on a 4.47" spacing. The height is usually 0.50" without heatsink.

**Full-bridge converter:** Four-transistor switching power supply configuration used to handle high power levels.

**Half-bridge converters:** Two-transistor switching power supply configuration used in medium-power applications.

**Half-wave rectifier:** Single-diode rectifier circuit that rectifies only one-half the input AC wave.

**Full-wave rectifier::** Rectifier circuit that rectifies both halves of an AC wave.

**Ground loop:** An unwanted feedback problem caused by two or more circuits sharing a common electrical line, usually a common ground line.

**Harmonic distortion:** AC current outputs with multiple harmonic frequencies to AC line frequency provoked by the switching devices in a power supply.

**Head room:** In a linear regulator, the head room is the difference between the secondary voltage supplied by the power transformer at nominal input voltage and the regulated output voltage. Head room is necessary to ensure proper regulation under full load and low input voltage operation.

**Heat sink:** Device used to conduct away and disperse the heat generated by electronic components.

**Hi-pot** (high potential voltage): See: Isolation test voltage.

**Holdup time:** The time under worst case conditions during which a power supply's output voltage remains within specified limits following the loss or removal of input power; also called "ride-through".

**Hybrid supplies:** A power supply that combines two or more different regulation techniques, such as ferroresonant and linears or switching and linear.

**IEC** (International Electrotechnical Commissions): An international safety agency headquartered in Geneva, Switzerland.

**Inhibit:** The ability to electrically turn off the output of a power supply from a remote location.

**Input voltage range:** The range of source voltages for which the power supply meets its specifications.

**Inrush current:** A high surge of input current that occurs in switchers and occasionally in linears upon initial turn on, caused by charging of the input capacitors.

**Isolating power supply** is a PSU that provides isolation between input and output. Isolation is absence of DC current pass between two circuits. Isolation in PSU is provided by transformers. Most of commercially available AC-DC PSU are isolating. Low input voltage DC-DC PSU are often non-isolating, such as a car phone charger. Note that isolation does not mean a complete absence of AC current path- some AC currents can still flow from input to output through physical and/or stray capacitance.

**Instantaneous current limiting circuit:** See: Cycle-by-cycle current limiting circuit.

**Insulation:** Material used to insulate a device by preventing or reducing the transmission of electricity.

**Inverter:** A power converter which changes DC Input power into AC output power.

**Isolation:** The degree of electrical separation between two points. It can be expressed in terms of voltage (breakdown), current (galvanic), or resistance and/or capacitance (impedance). In power supplies, it is important to maximize the input to output isolation.

**Isolation test voltage:** Ability of a power supply to withstand a high voltage potential placed either from the input terminals to ground, from any of the output terminals to ground, or between any pair of input and output terminals. This specification is important for safety reasons and is partially dependent on the mechanical design of the power supply.

**Leakage current:** Current flowing between the output buses and chassis ground due to imperfections in electronic components and designs. It must be tightly controlled to satisfy safety regulations such as UL and VDE.

**Line regulation:** The variation of an output voltage due to a change in the input voltage, with all other factors held constant. Line regulation is expressed as the maximum percentage change in output voltage as the input voltage is varied over its specified range.

**Linear** power supply is a PSU that regulates the output parameter (usually output voltage) by varying voltage drop across an electronic component placed in series with the load which dissipates unused power. This component may be a power semiconductor or a resistor. The regulation is accomplished by changing its effective resistance (if it is a power semiconductor) or by forcing extra current through it (if it is a resistor).

**Linear regulator:** A common voltage stabilization technique in which the control device (usually a transistor) is placed in series or parallel with the power source to regulate the voltage across the load. The term "linear" is used because the voltage drop across the control device is varied continuously to dissipate unused power.

**Load:** For voltage regulated power supplies, the load is the output current.

**Load regulation:** Variation of the output voltage due to a change in the output's load within a specified range with all other factors held constant. It is expressed as a percentage of the nominal DC output voltage.

**Logic inhibit:** The ability to turn a power supply off and on with TTL signals. A logic low generally allows the power supply to operate. A logic high turns off the power supply. See also: Logic low.

**Logic low:** A TTL voltage lower than 0.8 V. Also known as a "logic 0".

**Master/Slave operation:** In order to increase output power and provide redundancy should one converter fail, several converters are often connected in parallel. In most cases one type of converter is then used as master, controlling the other (slave) converters

**Modular:** A physically descriptive term used to describe a power supply made up of a number of separate subsections, such as an input module, power module, or filter module. Modular construction tends to lower the MTBF.

**MTBF** This measurement, expressed in hours, gives the relative reliability, and can be based on actual operation or on a calculated standard such as MIL

**Multiple output supply:** A power supply that delivers two or more different output voltages.

**Noise:** Noise is a periodic, random component of undesired deviations in output voltage. Usually specified in combination with ripple. See: PARD and also: Ripple.

**Nominal output voltage:** The intended, ideal voltage of any given output.

**Off-line** power supply is a PSU that takes its power directly from AC line without using line frequency transformer. Such supply can still be isolating if it uses high frequency transformer in one of its power conversion stages. A typical off-line SMPS rectifies input AC line voltage, converts it into high-frequency AC voltage by using semiconductor power switches, steps that voltage up or down by using inductors and/or transformers, then rectifies it again and filters for DC output. An example of isolating off-line PSU is a computer switching power supply.

**Open-frame construction:** A construction technique common to OEM power supplies where the supply is not provided with an enclosure. It can be either a simple printed circuit board or circuit board mounted on a metal chassis without a cover.

**Operating temperature:** The range of temperatures within which a power supply will perform within specified limits.

**Opto-isolator:** Device that provides electrical isolation and a signal path by making an electrical to optical to electrical signal transformation from its input to output terminals. This is accomplished with a light-emitting diode in close proximity to a phototransistor. Opto-isolators are used in the feedback loop to maintain electrical isolation between the input and output of the power supply. Ageing may provoke degraded feedback response.

**Output impedance:** The value of a fictional resistor in series with an ideal voltage source that would give the same magnitude of AC voltage across the supply terminals as observed for a particular magnitude and frequency of alternating current.

**Output voltage:** The voltage measured at the output terminals of a power supply; A feature or device that senses and responds to current or power overload conditions;

**Overcurrent protection:** See: Current limiting circuit.

**Overshoot:** The amount by which an output exceeds its final value in response to a rapid change in load or input voltage, measured as a percentage of the nominal. It is an important value at turn-on and following a step change in load or line voltage.

**OVP (overvoltage protection):** A protection mechanism for the load circuitry that does not allow the output voltage to exceed a preset level. In most cases, the output voltage is reduced to a low value, and the input power must be recycled to restore the power supply output

**Parallel operation:** The ability of power supplies to be connected so that the current from corresponding outputs can be combined into a single load.

**PARD:** Acronym for “Periodic And Random Deviation” and used as the specification term for ripple and noise. Ripple is the unwanted portion of the output harmonically (periodically) related in frequency to the input line and to any internally generated switching frequency. Noise is the unwanted, a periodic output deviation.

**Pass element:** The active circuit element, typically a transistor, that forms the output power stage of a linear power supply.

**Peak charging:** A rise in voltage across a capacitor caused by the charging of the capacitor to the peak rather than rms value of the input voltage. This generally occurs when a capacitor has a high discharge resistance across it and large ripple and noise or spikes on its input line. In a switcher, this parameter may affect minimum load conditions (discharge resistance) on each output required to maintain regulation.

**Peak transient output current:** The maximum peak current that can be delivered to a load during transient loading conditions, such as electric motor starts.

**Phase controlled modulation:** A circuit used in switching regulators where the operating frequency is held constant (typically 50 or 60 Hz line frequency) and the phase angle at which the control elements are turned on is varied, controlling both line and load changes with minimal dissipation.

**Pin fins:** Type of heatsink that uses pins in place of conventional extruded fins.

**Planar Magnetics:** Use of high volume manufacturing processes and technologies to replace conventional wire windings in magnetic components with patterned conductors formed on a single or multi-layer substrates. Planar magnetic offer advantages in terms of cost, reliability, manufacturability and predictable electrical parameters.

**Post regulator:** Usually a linear regulator used on the output of a switching or ferro power supply to improve overall (load) regulation.

**Power factor:** The ratio of actual power used in a circuit to the apparent power. Power factor is the measure of the fraction of current in phase with the voltage and contributing to average power.

**Power fail detect:** A circuit that senses the DC voltage across the input capacitors of a switching power supply. Should the AC input line fail, it senses an abnormally low DC level across the capacitors and provides an isolated TTL output signal warning of imminent loss of output power.

**Power supply or Power Supply Unit (PSU)** is a device that transfers electric energy from the source to the load using electronic circuits. A common application of power supplies is to convert raw input power into a regulated voltage and/or current required for an electronic equipment.

**Pre-regulator:** A regulator circuit that provides a line-regulated output, which is then processed by a second regulator, the post-regulator, which provides load regulation.

**Programming:** The capability of controlling the voltage of each output.

**Push-pull converter:** Used in switching power supplies where the main switching circuit uses two transistors operating in push-pull. The main advantage is simplicity of design.

**PWM (Pulse width modulation):** A circuit used in switching regulated power supplies where the switching frequency is held constant and the width of the power pulse is varied, controlling both line and load changes with minimal dissipation.

**Rated output current:** The maximum continuous load current a power supply is designed to provide under specified operating conditions.

**Recovery time:** The time required by a transient over or under shoot in a stabilised output quantity to decay within specified limits

**Redundancy:** The ability to connect power supplies in parallel so that if one fails the other will provide continuous power to the load. This mode is used in systems when power supply failure cannot be tolerated.

**Reference:** A known stable voltage to which the output voltage is compared for the purpose of stabilizing the output voltage.

**Regulated** power supply is a PSU that maintains a given output parameter (usually output voltage) to within specified limits under varying operating conditions, such as input line, output load, ambient temperature. PSU can be linear or switched-mode (switching) depending on the method of regulation and mode of operation of power handling components.

**Regulator:** The part of a power supply that controls the output voltage. In most cases, the regulator acts to stabilize the output voltage at a preset value.

**Remote on-off:** See: Inhibit.

**Remote sensing:** A method of moving the point of regulation from the output terminals to the load. Compensates voltage drops in the power distribution bus, but negative impact on dynamic load behaviour must be tolerated.

**Response time:** The time required (usually ms) for the output of a power supply or circuit to reach a specified fraction of its new value after a step change or disturbance.

**Return:** An arbitrary name for the common terminal for all the outputs. It carries the return current of all the outputs.

**Reverse voltage protection:** The ability of a power supply to withstand reverse voltage at the input terminals when hooked up in the reverse polarity.

**RFI (radio frequency interference):** See: EMI.

**Ripple:** The periodic AC component at the power source output harmonically related to source or switching frequencies.

**Ripple voltage:** The periodic AC component of the DC output of a power supply.

**Schottky diode:** A device that exhibits a low forward voltage drop (e.g. 0.4 V) and a fast recovery time. This type of diode is especially useful at high current, low voltage (typically 5VDC), where low losses and high switching speed are important.

**Semi-regulated output:** A secondary output on a multiple-output power supply that receives line regulation only.

**Sense line:** S+ and S- lines, complementary to the Vo+ and Vo- lines, allowing the compensation of voltage drops due to line resistance.

**Sequencing:** Controlling the time delay and order of output voltage appearance and drop-out upon power supply turn on and turn off.

**Series regulator:** A linear regulator in which the active control element (transistor) is in series connection with the load.

**Short-circuit protection:** See: Current limiting circuit.

**Shunt regulator:** A linear power supply in which the active control element (transistor) is in parallel with the load.

**Slave:** The unit in a master-slave paralleling scheme that is controlled by the master unit. See: Master/Slave operation.

**Snubber:** A network containing a resistor, capacitor, and diode used in the switching power supplies to trap high-energy transients and to protect sensitive components.

**Soft start:** Input surge-current limiting in a switching power supply where the switching drive is slowly ramped on.

**Stability:** The change in output voltage of a power supply over a specific period of time, following a warm up period, with all other operating parameters such as line, load and ambient temperature held constant.

**Standby current:** The input current drawn by any power supply under minimum load conditions.

**Static load:** A load that remains constant over a given time period. It is usually specified as a percentage of full load.

**Step change:** An abrupt and sustained change in one of the influence or control quantities (e.g. load current).

**Stress-ageing:** The process of subjecting a completed power supply to a variety of stresses to force the occurrence of all burn-in-failures.

**Surface Mount Technology (SMT):** A space saving technique whereby special leadless components are soldered onto the surface of a PCB rather than into holes in a PCB. The parts are smaller than their leaded versions and PCB area is thus saved.

**SMPS** or Switched-mode power supply is a PSU that incorporates power handling electronic components that are continuously switching on and off with high frequency in order to provide the transfer of electric energy. By varying duty cycle, frequency or a phase of these transitions an output parameter is controlled. Typical frequency range of SMPS is from 20 kHz to several MHz. The actual choice of operating frequency is usually the trade off between size and efficiency.

**Switching frequency:** The rate at which the source voltage is switched in a DC to DC converter.

**Switching regulator:** A high-efficiency non-isolated DC to DC converter consisting of inductors and capacitors to store energy and switching elements (typically transistors or SCRs), which open and close as necessary to regulate voltage across a load. The switching duty cycle is generally controlled by a feed-back loop to stabilize the output voltage.

**Synchronous Rectification:** A circuit arrangement where the output rectifier diodes of a power supply are replaced with active switches such as MOSFETs. The switches are turned on and off under control and act as rectifiers. This results in considerably lower losses in the output stage and subsequently much higher efficiency. They are particularly useful with low voltage outputs.

**Temperature coefficient:** The average percentage of change in output voltage per degree change in temperature with load and input voltage held constant.

**Thermal protection:** A protective feature that shuts down a power supply if its internal temperature exceeds a predetermined limit.

**Thermal regulation:** See: Temperature coefficient.

**Thermistor:** A device with relatively high electrical resistance when cold and almost no resistance when at operating temperature. Thermistors are sometimes used to limit inrush current in off-line switchers.

**Topology:** Topology is the fundamental circuit design of a clearly identifiable and characteristic type. DC-DC converters can be designed along several different topologies (using different fundamental design principles). A patent for a particular topology can be very powerful in that it can encompass any circuit solution regardless of power output, falling within the design principles of the topology in question.

**Transformer:** A magnetic device that converts AC voltages to AC voltages at any level. An ideal transformer is a lossless device in which no energy is lost and that requires no magnetising current.

**Transient:** A temporary and brief change in a given parameter. Typically associated with input voltage or output loading parameters.

**Transient response time:** The amount of time taken for an output to settle within some tolerance band, normally following a step change in load.

**UL (Underwriters' Laboratories):** An independent, non-profit organization testing for public safety in the United States.

**Undershoot:** The amount by which an output falls below its final value in response to a rapid load change.

**UPS or Uninterruptible power supply** is a PSU that continues to supply electric power to the load for specified periods of time during a loss of input power or when the input line varies outside normal limits. UPS is implemented with a backup battery and an additional DC-AC inverter.

**VDE (Verband Deutscher Elektrotechniker):** A German organization testing for public safety.

**Volt:** Unit of measurement of electromotive force, electric potential or potential difference (V).

**Voltage converter** technically has the same definition as the switching power supply, except the term converter is usually used for a single-stage DC-DC SMPS. A typical off-line switching power supply may consist of several cascaded voltage converters. The term converter may also imply an incomplete PSU, which may need additional components (filters, protective devices, housing, etc.) to make a complete PSU.

**Warm up drift:** The change in output voltage that occurs during warm-up from turn on of a cold supply until about 30 minutes after turn on. Warm-up drift is measured at constant load, input line, and ambient temperature and is primarily due to internal components reaching thermal equilibrium.

**Warm up time:** The time needed, after turn on, for the power supply to reach thermal equilibrium with a constant load. Usually estimated to be about 30 minutes.

**Watt:** Unit of measurement of power equal to 1 joule/sec (W). DC power can be calculated by multiplying voltage and current.