



SPD/TVSS Glossary of Terms - Courtesy of NEMA Surge Protection Institute (www.nemasurge.com)

A

ac filter - A power electronic device that eliminates harmonics, attenuates distortions and/or [EMI/RFI](#) noise.

Available interrupt current (AIC) - The highest current at rated voltage that a device is intended to interrupt under standard test conditions.

Alternating current (ac) - Electrical [current](#) which reverses direction periodically, expressed in [hertz](#) or [cycles per second](#). Abbreviated "ac". The number of such cycles per second equals the frequency in hertz, i.e. 60 cycles per second = 60 hertz (Hz), in the United States.

Attenuation - The reduction of a signal or electrical [surge](#) from one point to another. Wire [resistance](#), [arresters](#), and [power conditioners](#) attenuate surges to varying degrees.

B

Back Filter - A filter inserted in the power line feeding an equipment to be [surge](#) tested; this filter has a dual purpose: (1) To prevent the applied surge from being fed back to the power source where it may (might according to the word usage in this guide) cause damage. (2) To eliminate loading effects of the power source on the surge generator. (IEEE 100)

BIL - The basic impulse level or basic insulation level. To meet a given BIL rating a device must be able to withstand a simulated lightning wave that has a wave shape of 1.2 by 50 microseconds and in both positive and negative polarities. The wave reaches its peak in 1.2 microseconds and decays to ½ of the peak value in 50 microseconds. BIL ratings are expressed in kV (kilovolts).

Bonding - A complete and permanent electrical interconnection between two or more points (usually grounding systems) that reduces any [voltage](#) difference.

Branch circuit - An electrical circuit individually protected by a fuse or circuit breaker that starts at the service panel and ends at the electrical outlets.

Brownout -- A long-duration [under-voltage](#) condition, usually hours or days in length. Brownouts can be caused by heavy usage during peak hours, or they may be planned as an energy conservation strategy.

Building service entry - The point where commercial power enters the building.

C

Capacitance - A term referring to the electrical properties of a capacitor or to a circuit that displays capacitor-like behavior.

Category A, B, C - Categories of location for transient suppression within a facility. Class A refers to outlets and long branch circuits. Class B refers to major feeders and short branch circuits near the distribution panel. Class C refers to the commercial power service entrance and outside the facility (refer to [IEEE C62.41](#)).

CBEMA curve - A set of curves developed by the Computer Business Equipment Manufacturers Association (CBEMA) that represents the withstand capabilities of computers in terms of the magnitude and duration of a [voltage](#) disturbance. It was a standard for measuring the performance of all types of equipment and power systems until replaced by the Information Technology Industry Council ([ITIC](#)) curve.

Choke - A form of inductor which is constructed to allow desirable frequency signals to pass while acting with high impedance to other signals at some undesirable frequency.

Clamping voltage - The peak [voltage](#) that [SPDs](#) allow into an electric circuit based on a specific test waveform. See [Measured Limiting](#)

[Voltage](#)

Clean ground - An undefined term that describes an earth connection that does not cause electrical equipment to malfunction. See computer ground; or isolated ground.

Common mode noise (voltage) - Electrical noise between the power conductors and ground, i.e., between line and ground or between neutral and ground.

Coupling - The means by which power or signals transfer from one circuit element or network to another. Also, the effect of a power or signal source interfering with a signal transmission system.

Crowbar - A circuit that protects sensitive equipment by becoming a "crowbar" (or [short circuit](#)) between power conductors when conditions require it and temporarily shunting all current to ground and clamping the [voltage](#) to zero.

CSA - The abbreviation for [Canadian Standards Association](#), a Nationally Recognized Testing Laboratory headquartered in Canada.

D

Decibel (dB) - A logarithmic function used to simplify [MATV](#) calculations. Decibels may be added or subtracted. 0 dB is the standard reference level for all MATV calculations.

Delta - A standard three-phase circuit connection configured such that the ends of each phase winding connected in series form a closed loop with each phase 120 electrical degrees from the other. It appears as a triangle and looks like the Greek letter delta (Δ).

Differential-mode voltage - The [voltage](#) (noise) that appears across two specified sets of active conductors. See [transverse mode noise](#).

Diode - A two-terminal device that conducts [current](#) better in one direction than the other. It uses include rectification ([ac](#) to [dc](#) conversion) and detection (retrieving an information signal from a modulated carrier wave).

Dip - An undefined, imprecise term sometimes incorrectly used as a substitute for [sag](#).

Dropout voltage - The [voltage](#) at which a device fails to operate.

E

Earth ground - A low-[impedance](#) path to earth that discharges lightning, static, and radiated energy, and keeps the main service entrance at earth potential.

Electromagnetic interference (EMI) - A term that describes electrically-induced [noise](#) or [transients](#).

Electrostatic discharge (ESD) - The effects of static discharge can range from simple skin irritation for an individual to degraded or destroyed semiconductor junctions for an electronic device.

Equipment grounding conductor - The [conductor](#) that connects the non-current-carrying parts of [conduits](#), raceways, and equipment enclosures to the grounded conductor (neutral) and the grounding [electrode](#) at the service equipment entrance (main panel) or secondary of a separately derived system (e.g., isolation transformer). See Section 100 in [ANSI/NFPA 70-1990](#).

F

Farad - Unit of measurement for capacitance.

Fault - An unintentional [short circuit](#) that causes a failure or interruption in an electrical circuit or a power system.

Feeder - An electrical supply line, either overhead or underground, that connects from a generating plant or an interchange point to a [load](#) or distribution system.

Filter - An electronic device which opposes the passage of a certain [frequency](#) band while allowing other frequencies to pass. Filters are designed to produce four different results. A high-pass filter allows all signals above a given frequency to pass. A low-pass filter allows only frequencies below a given frequency to pass. A bandpass filter allows a given band of frequencies to pass while attenuating all others. A trap filter allows all frequencies to pass but acts as a high-impedance device to the tuned frequency of the filter.

FIPS Pub. 94 (Federal Information Processing Standards Publication 94) (September 21, 1983), -- Produced as an official publication of the National Bureau of Standards (since renamed [National Institute for Standards and Technology](#)). It gives guidelines for federal agencies in the use of automatic data processing (ADP) facilities in an electrical environment.

Flashover - Arcing that is caused by the breakdown of insulation between two [conductors](#) where a high [current](#) flow exists, with a high potential difference between the conductors.

Follow current - [Current](#) supplied by the electrical power system and flowing through the [SPD](#) during and following the passage of discharge current.

Frequency - The number of times in a specific period (how frequently, usually in [cycles per second](#)) alternating current ([ac](#)) reverses its direction, measured in [hertz](#) (Hz). Each reversal from one direction to another and back again constitutes a cycle. In North America, utilities provide power with a frequency of 60 cycles per second, or 60 hertz. In ac circuits, designates number or times per second that the current completes a full cycle in positive and negative directions. See also [alternating current](#).

Fuse - An [overcurrent](#) protective device with a fusible link that operates and opens the circuit on an overcurrent condition.

G

GFI (Ground Fault Interrupter) - A device that interrupts the flow of electric current in an electric circuit when the fault current to ground exceeds some predetermined value.

Ground - A general term that refers to the point at which other portions of a circuit are referenced when making measurements. Power systems grounding is that point to which the neutral conductor, safety ground, and building ground are connected. This grounding electrode may be a water pipe, driven ground rod, or the steel frame of the building.

Ground electrode - A [conductor](#) or group of conductors in contact with the earth that provides a low-[impedance](#) connection to the [ground](#).

Ground fault - Any undesirable current path from a current-carrying [conductor](#) to [ground](#).

Ground grid - A system of interconnected bare [conductors](#) arranged in a pattern over a specified area, on a buried below the surface of the earth, that provides safety for workers by limiting potential differences within its perimeter to safe levels. It does not act as a signal reference grid.

Ground loop - The condition of having two or more [ground](#) references in a common system. When two or more grounds have a potential difference between them, [current](#) can flow. This flow of current is a new circuit or loop which can interfere with the normal operation of the system.

Ground noise - An undefined, imprecise term that describes unwanted electrical signals appearing between the earth [conductor](#) and any other conductor.

Ground potential rise (GPR) - When a large amount of energy is rapidly deposited into the ground by a cloud-to-ground lightning strike or by an electrical fault on a utility power system, the ground potential at this injection point rises to a higher level with respect to the more distant ground. This has the effect of creating a [voltage](#) potential gradient in the earth, which can cause dangerous touch and step potentials to personnel exist. By creating an equi-potential ground plane beneath a facility by electrically bonding all separate "grounds" into a "system" or by burying ground mats and meshes, this danger to personnel and equipment can be reduced. It is also important to note that GPR is not only dangerous to personnel, it can also cause damage to equipment.

H

Harmonic - A [frequency](#) that is a multiple of the fundamental frequency. For example, 120 Hz is the second harmonic of 60 Hz, 180 Hz is the third harmonic, and so forth.

Harmonic distortion - Excessive [harmonic](#) content that distorts the normal sinusoidal [waveform](#) is harmonic distortion. This can cause overheating of circuit elements and might appear to a device as data-corrupting noise.

Harmonic resonance - The power quality term that describes the condition that sometimes occurs in electrical systems in which high currents flow through and damage capacitors or clear fuses in connecting circuits. A condition in which the power system resonates at one of the major [harmonics](#) produced by nonlinear elements in the system and increases the harmonic distortion.

Henry - Unit of measurement for [inductance](#).

Hertz - A term describing the frequency of [alternating current](#). The term hertz is synonymous with [cycles per second](#). Abbreviated Hz.

High-pass filter - A filter that passes all [frequencies](#) above a certain level, and stops all lower frequencies.

I

IEC - The [International Electrotechnical Commission](#) (IEC) is an international standards-setting body for electrical and electronic technologies.

IEEE - The [Institute of Electrical and Electronic Engineers](#) (IEEE) is an international society of engineers that develops its own standards.

Impedance - Measured in [ohms](#), impedance is the total opposition to [current](#) flow in a circuit where alternating current is flowing. This includes [inductive reactance](#), capacitive reactance, and [resistance](#). Symbol is Z.

Impulse - A surge of unidirectional polarity. Ref: IEEE.

Inductance - This term describes the electrical properties of a [conductor](#) and its resultant magnetic field when an [alternating current](#) is passed through it. This interaction offers an [impedance](#) to current flow, thereby causing the current [waveform](#) to lag behind the voltage waveform. This results in what is known as a lagging power factor.

Insertion loss - Also called "feed through loss". This is the loss that occurs as signals pass through a passive device. Insertion loss occurs in all devices which do not amplify the signal.

Inrush current - The initial large current demand needed to start up certain types of electrical equipment, like motors, before their resistance or impedance increases to their normal operating value.

Insulation (electrical) - A dielectric substance or air space permanently offering a high resistance to the passage of current and to disruptive discharge through the substance or space. For example, a non-electrical-conducting material, like rubber or polyethylene, is used to resist current flow.

Isolation - The degree to which a device can separate the electrical environment of its input from its output, while allowing the desired transmission to pass across the separation.

Isolated ground - An insulated equipment grounding conductor that runs in the same conduit or raceway as the supply conductors and is insulated from the metallic raceway and all ground points throughout its length. It originates at an isolated ground-type receptacle or equipment input terminal block and terminates at the point where neutral and ground bond at the power source. See [NFPA 70-1990](#), Section 250-74, Exception 4, and Section 250-75, Exception.

Isolation transformer - A multiple-winding [transformer](#) with physically separate primary and secondary windings that allows the [magnetic field](#) in the winding of the primary to create (induce) electrical power in the secondary winding but minimizes [electrostatic transfer](#) to the secondary windings. This way the electrical power available at the input transfers to the output, but some of the unwanted electrical effects in the input power do not reach the transformer's output.

ITIC ([Information Technology Industry Council](#)) - replaced the former Computer Business Equipment Manufacturers Association.

K

k-rated transformer - A [transformer](#) specially designed to handle [harmonics](#).

L

Line filter - A filter in series with a transmission line that removes unwanted electrical signals.

Line to Neutral (L-N) - A term used to describe a given condition between a phase [conductor](#) and a neutral conductor.

Low-pass filter - A filter that passes all [frequencies](#) below a certain designated cutoff point and blocks all frequencies above that point.

M

Main service entrance -- The enclosure that contains connection panels along with fuses or breakers, and located at the point where the utility power lines enter a building.

Maximum continuous operating voltage (MCOV) - The maximum designated root-mean-square ([rms](#)) value of power-frequency [voltage](#) that may be applied continuously between the terminals of the [arrester](#). Ref. IEEE 100.

Measured limiting voltage - The maximum magnitude of [voltage](#) that appears across the terminals of the SPD during the application of an impulse of specified waveshape and amplitude. (IEC TC 37)

Metal oxide varistor (MOV) - A solid state device which becomes conductive when the [voltage](#) across it exceeds a certain level. When the voltage exceeds the MOV's threshold, [current](#) flows through the MOV.

Multi-Port SPD - Pending a resolution of different definitions among standard-writing bodies, the terms 'multi-port' has not been used in this protocol.

N

National Electrical Code[®] - A set of rules and regulations, plus recommended electrical practices, published by the [National Fire Protection Association](#). Abbreviated NEC.[®]

NEMA - The [National Electrical Manufacturers Association](#) (NEMA) is a standards-setting body for electrical equipment.

Neutral - The grounded junction point of the legs of a [wye](#) circuit or the grounded center point of one coil of a delta transformer secondary.

Noise - An undesirable signal. A distortion of the normal [sine wave](#). Can be caused by radar and radio transmitters, fluorescent lights, power control circuits, aging utility and industrial equipment.

Nonlinear load - A [load](#) in which the current varies with the [voltage](#) in a nonlinear fashion. For example, in a switched-mode power supply or almost any other electronic power supply. The current does not vary in direct proportion to the voltage because it uses power in pulses or other waveforms that do not track the sine wave.

Normal mode (NM) - Refers to electrical interference measured between line and neutral (current-carrying conductors). The operation of lights, switches and motors generates normal-mode interference.

O

One-port SPD - A surge protective device ([SPD](#)) having provisions (terminals, leads, plug) for connection to the [ac](#) power circuit but no provisions (terminal, leads, receptacles) for supplying current to the ac power [loads](#) ([UL 1449-1998](#))

Open-circuit voltage (OCV) - The voltage available from the test set up (surge generator, coupling circuit, back filter, connecting leads) at the terminals where the surge protective device ([SPD](#)) under test will be connected. (SC definition)

Oscillatory transient - A power quality term that describes a [voltage](#) or [current transient](#) that rises suddenly and sharply to some level and then degrades over time to a [waveform](#) that decreases in frequency and amplitude.

P

Passive filter - A combination of inductors, capacitors, and resistors that eliminates one or more harmonics. The most common type simply uses an inductor in series with a shunt capacitor, which diverts the major distorting harmonic component from the circuit.

Peak - The maximum instantaneous measurement of an electrical event.

Phase - The stage or progress of a cycle movement, such as a current or [voltage](#) wave. Also a conductor that carries one of three separate phases (designated, A, B, and C) of power in an alternating current system. Almost all residential customers use either two-phase or three-phase service.

Power quality - A general term describing the powering and grounding of electronic equipment in a manner suitable to the operation of the equipment and compatible with the premise wiring system and other connected equipment.

R

Radio-Frequency Interference (RFI) - Electromagnetic signals of a frequency associated with electromagnetic radiation which are

coupled to a conductor either directly or as with an antenna.

Reactance - A physical property of a circuit component that tends to hinder the flow of alternating current.

Reflection - The return wave created when a traveling wave encounters [load](#), a source, or a junction that has a change in line impedance.

Resistor - A discrete electronic component designed to produce a [dc voltage](#) drop when dc [current](#) passes through it.

Resonance - The condition that occurs when the capacitive reactance equals the inductive reactance of a circuit.

Response time - The time required, after the initiation of a specified disturbance to a device or system, for an output to reach a specified value.

RFI (Radio-Frequency Interference) - Electromagnetic signals of a frequency associated with electromagnetic radiation which are coupled to a conductor either directly or with an antenna.

S

Sag (also called dip or voltage sag) - An [RMS](#) reduction in the ac voltage, at the power frequency, for durations from a ½ cycle to a few seconds. Ref. IEEE 1100.

Secondary circuit - The distribution circuit on the low-[voltage](#) side of a transformer (usually 120/240 V).

Semiconductor - An electronic conductor (e.g., silicon, selenium, or germanium) with a resistivity between metals and insulators that allows current to flow through it normally via holes or electrons.

Service entrance equipment - The main control and means of disconnection for the supply of electricity to a building that usually contains circuit breakers, switches, and fuses.

Shielding - Protective coating that helps eliminate electromagnetic and radio frequency interference.

Short Circuit - An accidentally established connection between two points in an electric circuit, as when a tree limb or an animal bridges the gap between two conductors. This will cause an overload of current on the line, causing damaged lines, blown fuses, and the operation of protective devices such as reclosers and circuit breakers.

Short Circuit Current (SCC) - The current which the test set up (surge generator, coupling circuit, back filter, connecting leads) can deliver at the terminals where the SPD under test will be connected, with the SPD replaced by bonding the two lead terminals. (Also sometimes abbreviated as "SCI") (SC definition)

Short Circuit Current Rating (SCCR) - The capacity of current with which the tested SPD can withstand at the terminals where connected, without breaching the enclosure in any way. Part of a [UL 1449](#) Listing Classification (Section 37.3), as required by [NFPA 70](#), Section 285.6. (NEC 2002)

Shunt filter - A filter connected in parallel across a device or circuit to filter out undesirable signals.

Silicon avalanche diode - A [semiconductor](#) device that normally acts as an open circuit but changes to a short circuit when the trigger [voltage](#) exceeds a certain amount.

Silicon Controlled Rectifier (SCR) - A device that acts as an electronic [dc](#) switch when triggered to conduct by a pulse or a gate signal, and cuts off the flow of electricity by reducing the main current below a predetermined level (usually zero).

Single-phase condition - An unusual condition where one phase of a three-phase system is lost, causing unusual effects on lighting and other loads.

Single-Point Ground - The practice of tying the power neutral ground and safety ground together at the same point, thus avoiding a differential ground potential between points in a system.

Skin effect - The tendency of a high frequency current flowing in a conductor to flow near the surface of the conductor. The current may be a radio frequency or a transient surge current.

SPD disconnect - A device for disconnecting a surge protective device ([SPD](#)) from the system in the event of SPD failure. It is to prevent a persistent fault on the system and to give visible indication of the SPD failure. Note: At least three functions are needed for SPD disconnectors: protection against thermal problems (such as thermal runaway on [varistors](#)), protection against internal short circuits and protections against indirect contact. These functions may be achieved by one or several devices. They may be used in the SPD circuit or

in the mains. (IEC TC37)

Spark gap - Any short air space between two conductors electrically insulated from each other; or a device that depends on a spark gap for its operation.

SPD - See [Surge-Protective Device](#)

Spike (or impulse, switching surge, lightning surge) - These terms refer to a [voltage](#) increase of very short duration (microsecond to millisecond). Spikes may be caused by lightning, switching of heavy loads, and/or [short circuits](#) or power system faults.

T

Temporary Overvoltage (TOV) - An oscillatory over-voltage that is undamped or slightly damped.

Three phase - An electrical system with three different [voltage](#) lines or legs, which carry [sine-wave](#) waveforms that are 120° out-of-phase from one another.

Thermal runaway - An operational condition when the sustained power loss of an [SPD](#) exceeds the dissipation capability of the housing and connections, leading to a cumulative increase in the temperature of the internal elements culminating in failure. (IEC TC37)

Thyristor - A semiconductor bistable switch (with on and off states) that operates uni-directionally or bi-directionally. A three-terminal device (a controlled rectifier) or a two-terminal device (diode may trigger it).

Transformer - A device used for changing the [voltage](#) of an [ac](#) circuit and/or isolating a circuit from its power source.

Transient - An electrical event of a nonrepetitive nature. the term is used interchangeably with the term "[impulse](#)"; however, the term relates more to the intermittent occurrence of "[surges](#)" and "[sags](#)". A short duration, fast-rise-time [voltage](#) caused by lightning, large motors starting, utility switching operations, and other appliances switching.

Transient voltage surge suppressor (TVSS) - A surge protective device intended for connection electrically on the load side of the main overcurrent protection in circuits not exceeding 600 volts [RMS](#). Ref. UL 1449.

Triplen harmonics - Odd multiples of the third harmonic, which deserve special attention because of their natural tendency to add to each other.

Two-port SPD - A surge protective device (SPD) with two sets of terminals, input and output. A specific series impedance is inserted between their terminals. Note – The measured limiting [voltage](#) may be higher at the input terminals than at the output terminals. Therefore, equipment to be protected must be connected to the output terminals. Ref. IEEE TC37.

U

UL 1449 (Underwriters Laboratories [Standard Number 1449](#)) - A nationally recognized set of guidelines used by UL to evaluate [transient voltage surge suppressors](#).

V

Varistor - A [semiconductor](#) device whose [resistance](#) varies with the applied [voltage](#).

Voltage - Electrical pressure, or electromotive force (emf). The force that causes current to flow through a conductor, expressed as a difference of potential between two points, since it is a relational term. Connecting both voltmeter leads to the same point will show no voltage present, although the voltage between that point and ground may equal hundreds or thousands of volts. Thus, most nominal voltages are expressed as phase to phase or phase to neutral. The unit of measurement is volts and the electrical symbol is V.

Voltage-limiting type SPD - A surge protective device ([SPD](#)) that has a high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage. Common examples of components used as nonlinear devices are: varistor and suppressor diodes. These SPDs are sometimes called 'clamping type'. Note – A [voltage](#)-limiting device has a continuous V versus I characteristic. Ref. IEC TC37.

Voltage-switching type SPD - An SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a low value in response to a [voltage](#) surge. Common examples of components used as nonlinear devices are: spark-gaps, gas tubes, thyristors and triacs. These SPDs are sometimes called "crowbar type". Note – A voltage-switching device has a discontinuous V versus I characteristic. Ref. IEC TC37.

W

Wye - A wye connection refers to a polyphase electrical supply where the source transformer has the conductors connected to the terminals in a physical arrangement resembling a Y. Each point of the Y represents the connection of a hot conductor. The angular displacement between each point of the Y equals 120. The center point provides the common return point for the neutral conductor.

Z

Zigzag transformer - A special type of transformer used to change the phase angle of the transformer primary.

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