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***for Electrostatic Discharge
Terminology***

Glossary



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EOS/ESD Association, Inc.



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ESD ASSOCIATION ADVISORY FOR ELECTROSTATIC DISCHARGE TERMINOLOGY – GLOSSARY

1.0 PURPOSE

The purpose of this glossary is to promote technically correct terminology in the electrical overstress/electrostatic discharge (EOS/ESD) community.

2.0 SCOPE

This document contains unified definitions and explanations of terminology used in the standards, standard practices, standard test methods, technical reports, and other documents of EOS/ESD Association, Inc. The glossary compares EOS/ESD industry terminology with the more familiar usages of electrical and electronic terms. Although the glossary is not intended to be an encyclopedia, it includes historical information (including explanations of obsolete terminology) and clarifies terminology in other EOS/ESD-related documents.

The glossary is revised as needed so that it evolves continually along with the evolving knowledge of EOS/ESD phenomena and protective methods.

New revisions of the glossary cover all issued standards, standard practices, standard test methods, and technical reports in effect at the time of the revision, but not necessarily draft documents. At the time of each edition's publication, the glossary includes the most recent updates of the definitions from all issued EOS/ESD Association, Inc. standards documents.

3.0 DEFINITIONS

AC equipment ground

- a) The ground point at which the equipment grounding conductor is bonded to any piece of equipment, at the equipment end of the conductor in a single-phase 120VAC electrical service.
- b) The 3rd wire (green/green with yellow stripe) terminal of a receptacle.
NOTE: Wiring colors may vary by National Electrical Code.
- c) The entire low impedance path (electrically equivalent to the equipment grounding conductor) from a piece of electrical equipment to the neutral bus at the main service equipment).

acceptance equipment

An instrument or collection of instruments that meet the criteria of a standard or standard test method and provides a measurement that is repeatable. It may or may not be as accurate as laboratory evaluation equipment. This equipment is typically used to verify materials, devices or procedures under in-use conditions.

acceptance testing

Incoming tests to confirm proper marking and electrical functionality. Data are the form of visual inspection records, and values or pass/fail notation.

active components

Semiconductor devices and elements such as transistors and diodes, amplifiers, and rectifiers that can change their basic characteristics in a powered electrical circuit.

air conductivity

The ability of air to conduct (pass) an electric current under the influence of an electric field.

air ions

Molecular clusters of about 10 molecules (water, impurities, etc.) bound by polarization forces to a singly charged oxygen or nitrogen molecule.

air ionizer

A source of charged air molecules (ions).

amplitude

The value chosen to be specific to the waveform, typically the difference between the baseline and the first peak.

ankle strap

See ground strap.

anti-parallel diodes (APD) (a.k.a. back-to-back diodes, pass diodes)

A pair of diodes with anode of diode 1 connected to cathode of diode 2 and cathode of diode 2 connected to anode of diode 1. Can be used to enable ESD protection between power nets with potential voltage difference during normal operation smaller than diode turn-on voltage (e.g. protect separate grounds).

antistat, agent

A substance that is part of or topically applied to a material to render the material surface static dissipative or less susceptible to triboelectric charging.

antistatic

Usually refers to the property of a material that inhibits triboelectric charging. Note: A material's antistatic characteristic is not necessarily co-relatable with its resistivity or resistance.

associated non-supply pin

A non-supply pin (typically an I/O pin) is associated with a supply pin group if either a) the circuit from the supply pin group (i.e., VDDIO) is required for the function of the electrical circuit(s) (I/O driver) that connect (high/low impedance) to that non-supply pin; or b) a parasitic path exists between non-supply and supply pin (e.g., open-drain type non-supply pin to a VCC supply pin group that connects to a nearby N-well guard ring).

attenuator

A resistive network with coaxial connectors to reduce the amplitude of a signal by a specified amount.

automated handling equipment (AHE)

Any form of self-sequencing machinery that manipulates or transports product in any form; e.g. wafers, packaged devices, paper, textiles, etc.

auxiliary ground

A separate supplemental grounding conductor for use other than general equipment grounding.

bandwidth

The high frequency limit where the amplitude of a component of system has decreased to 0.707 (-3 dB) of the constant amplitude low frequency response.

barrier strip

A device or apparatus that consists of a metal strip and connectors or screws that allows termination and connection of wires or conductors from various components of an electrostatic discharge protected workstation.

bipolar ionizer

A device that generates both positively and negatively charged ions.

body contacting mechanism (BCM)

The part of the foot grounder that makes electrical contact with the body.

body contact point (BCP)

The portion of the ESD control item that makes electrical contact with the human body. For a garment, this may be a conductive cuff or a device that takes the place of a wrist strap or a wristband type grounding mechanism for contact to the wrist of the test subject.

bond or bonding

The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to safely conduct any current likely to be imposed.

bonding conductor

The wire, strap, flange or other electrically conductive mechanical device used to interconnect two otherwise isolated conductive or dissipative items.

breakaway force

The force required to disconnect the ground cord from the cuff.

bump (package bump, package ball)

Electrical contact on the IC package to connect it to the traces on the circuit board.

bus bar

A metal strip or bar to which several conductors may be bonded.

bypass capacitor

A capacitor placed between power and ground to provide a more stable power supply voltage by shunting high frequency signals (such as device switching noise) and/or to provide local power storage (to reduce supply voltage variations when device current usage changes).

cable discharge current

A current produced by causing a stored charge to flow in or out of a cable conductor.

cable discharge event (CDE)

Occurrence of an electrostatic discharge event when the cable is connected to an electrical system or equipment. Examples of sources include ethernet cables, T1 lines, and other communications or data lines.

charge decay

The decrease and/or neutralization of a net electrostatic charge.

charge induction

The displacement of charge in an isolated conductor when placed in an electric field (for example, from a charged body).

NOTE: Momentary grounding of such a conductor would result in its gaining a net charge.

charged device model (CDM) electrostatic discharge (ESD)

An ESD stress model that approximates the discharge event that occurs when a charged component is quickly discharged to another object at a lower electrostatic potential through a signal pin or terminal.

charged device model (CDM) electrostatic discharge (ESD) tester

Equipment that simulates the component level CDM ESD event using the non-socketed test method.

charged plate monitor (CPM)

An instrument used to measure the charge neutralization properties of ionization equipment.

coaxial resistive probe

A resistor (for example, a 1.0 ohm disk resistor) used to measure the CDM discharge current.

coaxial transmission line

A coaxial cable with controlled impedance used for transferring a signal with minimum loss from one point of the system to another.

cold healing

The spontaneous recovery, at room temperature, of an item from a parametric change caused by electrostatic discharge.

cold workstation

A work area that has items, assemblies, black boxes, or systems which no power is applied.

common connection point

A device or location (less than 1 ohm within itself) where the conductors of two or more ESD technical elements are connected in order to bring the ungrounded ESD technical elements to the same electrical potential through equipotential bonding.

common point ground

A grounded device or location where the conductors of one or more technical elements are bonded.

compliance (periodic) verification

Testing done to indicate that the performance has not changed from initial baseline values to exceed selected limits.

compliance verification (periodic testing) equipment

An instrument or collection of instruments that provide an indication or measurement. It may or may not be repeatable or accurate. This equipment is typically used for indications of pass or fail.

component

An item such as a resistor, diode, transistor, integrated circuit or hybrid circuit. A component may also be referred to as a device.

component failure

A condition in which a tested component does not meet one or more specified static or dynamic data sheet parameters.

component under test (CUT)

A passive or active element, device, integrated circuit, module or subsystem being tested. The CUT is intended to become part of a completed system but is not the entire system.

compressed gas ionizer

Ionization devices that can be used to neutralize charged surfaces and / or remove surface particles with pressurized gas. This type of ionizer may be used to ionize the gas within production equipment.

conductive flooring material

A floor material that has a resistance to ground of less than 1.0×10^6 ohms.

conductive material, resistance

A material that has a surface resistance of less than 1×10^4 ohms or a volume resistance of less than 1×10^4 ohms.

conductive material, resistivity

A material that has a surface resistivity less than 1×10^5 ohms/square or a volume resistivity less than 1×10^4 ohm-cm.

conductivity

- a. The ratio of the current per unit area (current density) to the electric field in a material. Conductivity is expressed in units of siemens/meter.
- b. In non-technical usage, the ability to conduct current.

constant area and force electrode (CAFÉ)

An electrode designed to be held by a person's finger, gloved or ungloved, to reproducibly measure resistance from the finger to a counter electrode such as a ground strap worn on the wrist of the same hand. This electrode is suitable for measuring the resistance of a finger wearing a finger cot.

contact-mode discharge

An ESD event initiated within a relay. The relay is connected to the component pin via a probe, and the component is not in a socket.

contact-mode, non-socketed discharge

See constant-mode discharge.

contact voltage measurement

A measurement technique using high input impedance circuitry used to monitor the voltage induced on a conductive plate where there is a direct connection from the circuitry to the conductive plate.

corona

The production of positive and negative ions by a very localized high electric field. The field is normally established by applying a high voltage to a conductor in the shape of a sharp point or wire.

correlation sample

A representative device used for correlating measured voltages with known applied voltages.

coupled non-supply pin pair

Two pins that have an intended direct current path (such as a pass gate or resistors), such as differential amplifier inputs, or low voltage differential signaling (LVDS) pins. They include analog and digital differential pairs and other special function pairs (e.g., D+/D-, XTALin/XTALout, RFin, RFout, TxP/TxN, RxP/RxN, CCP_DP/CCN_DN, etc.).

critical path components

Any portion of the AHE within a certain distance of the device path. That distance should be agreed upon between the manufacturer and end user.

cuff

The portion of a garment's sleeve towards the end near the hand. This may be a conductive cuff or a device that takes the place of a wrist strap or a wristband type grounding mechanism that makes electrical contact with the body.

current limiting resistance

A resistance value incorporated in series with the wrist strap or foot grounder's electrical path to ground. This resistance limits electrical current that could pass through the grounding mechanism in the event of inadvertent user contact with electrical potential.

current sense resistor

A resistor, R_{CS} , of less than five ohms which produces a measurable voltage proportional to current through it with an intrinsic rise-time response three times faster than the fastest rise-time to be measured. $\Delta v = \Delta i \times R_{CS}$.

current sensor

A device used to measure the current in a circuit or system. This device could be non-invasive (by sensing the change in magnetic flux lines) or be very low impedance inserted in series (such as the ESD target).

current source method

A TLP methodology (sometimes referred to as constant current method) that utilizes a 500 ohm resistor in series with the DUT and measures the voltage and current at the DUT.

current/voltage ringing duration

The current/voltage ringing duration is defined as the length of time between the beginning of the current/voltage pulse and the time that the pulse settles and remains within 95% and 105% of the pulse plateau.

data sheet parameters

The static and dynamic component performance data supplied by the component manufacturer or supplier.

DC resistance

The ratio of the DC voltage applied to a conductor to the DC current through it.

decay rate

The decrease of charge or voltage per unit time.

decay time

The time required for an electrostatic potential to be reduced to a given percentage (usually 10%) of its initial value. (See static decay test.)

delay line

A transmission line used to introduce signal delay between two components of a system.

DeNMOS

Drain extended NMOS used as specific high voltage device in advanced CMOS technologies (compare to LDMOS).

design rule check (DRC)

A process in which the circuit (in schematic or layout views) is compared for compliance to one or more sets of pre-defined rules meant to ensure circuit manufacturability.

destructive damage

Damage where the operating electrical characteristics or parameters are altered and do not recover to the initial conditions prior to stress.

device

Product being processed by AHE (e.g., an integrated circuit [IC] or a printed circuit [PC] board).

device path

The route traveled by a device in an AHE.

device under test (DUT)

The device to which the Transient Stimulus will be applied.

di/dt

Current derivative: the slope of the tangent at a particular point in time of the current signal.

dielectric

An insulating material that can sustain an electric field with little current flow.

dielectric breakdown voltage

The electric potential across an insulating material that causes a sudden increase in current through the material of the insulator.

dielectric strength

The maximum electric field that a dielectric can sustain.

direct pin test generator

A test generator which complies with the minimum requirements in the IEC 61000-4-2 standard, with a contact discharge tip.

discharge current

A current produced by causing a stored charge to flow out of a component into a conductor from an ESD simulator.

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discharge time

The time necessary for a voltage (due to an electrostatic charge) to decay from an initial value to some arbitrarily chosen final value.

discrete component

An elementary electronic device constructed as a single unit such as a transistor, resistor, capacitor, inductor, diode, etc.

dissipative floor material

A floor material that has a resistance to ground of greater than 1.0×10^6 ohms and less than or equal to 1.0×10^9 ohms.

dissipative materials

A material that has a surface resistance greater than or equal to 1×10^4 ohms but less than 1×10^{11} ohms or a volume resistance greater than or equal to 1×10^4 ohms but less than 1×10^{11} ohms.

DRC

See Design Rule Check

dynamic parameters

Parameters measured with the component in an operating condition. These may include, but are not limited to, full functionality, output rise and fall times under a specified load condition, and dynamic current consumption.

dynamic state

Any operational state where the device is functioning according to its design. Typically, inputs, I/O, and output pins are changing as a required to operate the device. In the dynamic state, the supply current should be changing throughout the range of I_{DDNOM} .

earth grounding electrode

The metal rod, metal plate, metal pipe, metal mesh, metal underground water pipe, or grounded metal building frame that are bonded to the neutral bus at the main service entrance.

EDA

See Electronic Design Automation

electric charge

An absence or excess of electrons.

electric field shielding materials

A material that has a surface resistance or a volume resistance of less than 1×10^3 ohms.

electrical ionizer

A device that creates ions in gases by use of high voltage electrodes.

electrical overstress (EOS)

The exposure of an item to a current or voltage beyond its maximum ratings. This exposure may or may not result in a catastrophic failure.

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electrical rule check (ERC)

A method and tools to verify the compliance of an integrated circuit (in schematic or layout representations) to a set of pre-defined connectivity rules based on voltage or current restrictions for the circuits.

electrification period

The average of five (5) electrification times, plus five (5) seconds.

electrification time

The time for the resistance measuring instrument to stabilize at the value of the upper resistance range verification fixture.

electronic design automation (EDA)

A category of software tools for developing, designing and verifying electronic circuits.

electrostatic charge

Electric charge at rest.

electrostatic damage

Change to an item caused by an electrostatic discharge that makes it fail to meet one or more specified parameters.

electrostatic discharge (ESD)

The rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field. Note: Usually, the charge flows through a spark between two bodies at different electrostatic potentials as they approach one another. Details of such processes, such as the rate of the charge transfer, are described in specific electrostatic discharge models.

electrostatic discharge (ESD) control

See static control.

electrostatic discharge (ESD) ground

The point, electrodes, bus bar, metal strips, or other system of conductors that form a path from a statically charged person or object to ground.

electrostatic discharge (ESD) protective

A property of materials capable of one or more of the following: reducing the generation of static electricity, dissipating electrostatic charges over its surface or volume, or providing shielding from ESD or electrostatic fields.

electrostatic discharge (ESD) protective symbol

The graphics used to identify items that are specifically designed to provide electrostatic discharge protection.

electrostatic discharge (ESD) protective workstation

An area that is constructed and equipped with the necessary protective materials and equipment to limit damage to electrostatic discharge susceptible items handled therein.

electrostatic discharge (ESD) protective worksurface

A worksurface that dissipates electrostatic charge from materials placed on the surface or from the surface itself.

electrostatic discharge sensitivity (ESDS)

The ESD level that causes component failure.

NOTE: See also electrostatic discharge susceptibility.

electrostatic discharge (ESD) shield

A barrier or enclosure that limits the passage of current and attenuates an electromagnetic field resulting from an electrostatic discharge.

electrostatic discharge (ESD) spark testing

Testing performed with operating equipment or parts to determine their susceptibility to the transient electromagnetic fields produced by an air discharge event.

electrostatic discharge susceptibility (ESDS)

The propensity to be damaged by electrostatic discharge. (See also electrostatic discharge sensitivity).

electrostatic discharge susceptibility (ESDS) classification

The classification of items according to electrostatic discharge susceptibility voltage ranges. Note: There are various classification methods.

electrostatic discharge susceptibility (ESDS) symbol

The graphics placed on hardware, assemblies, and documentation for identification of electrostatic discharge susceptible items.

electrostatic discharge susceptible (ESDS) item

Electrical or electronic piece part, device, component, assembly, or equipment item that has some level of electrostatic discharge susceptibility.

electrostatic field

An attractive or repulsive force in space due to the presence of electric charge.

electrostatic potential

The voltage difference between a point and an agreed upon reference.

electrostatic shield

A barrier or enclosure that limits the penetration of an electrostatic field.

electrostatics

The study of electrostatic charge and its effects.

emitter

A conducting sharp object, usually a needle or wire, which will cause a corona discharge when kept at a high potential.

energized

The state of a piece of equipment such that it carries electrical, fluid, thermal, mechanical or other form of energy in a state which could pose a hazard to personnel.

EOS

See electrical overstress.