

Glossary of Electronic Assembly

Acceptable Quality Level: The maximum number of defects per every 100 units that are considered to be satisfactory as a process average.

Acrylic: A synthetic resin made from acrylic acid or a derivative thereof. Acrylics possess the property of transparency, as well as offer flame resistance.

Activated Rosin Flux: A mixture of rosin and small amounts of organic-halide activators or organic-acid activators.

Activators: A substance that enhances the ability of a flux to remove oxides and other contaminants from surfaces being joined.

Active Components: Electronic components such as semiconductors, transistors, diodes, etc., that can operate on an applied electrical signal and change its basic characteristics (e.g., switching, amplification, rectification).

Active Hold-Down: The process of pressing a component lead directly in contact with a bonding pad during soldering to ensure intimate contact between the lead and pad. Intimate contact is important for proper heat transfer through the lead to reflow the solder. This is a characteristic of hot bar soldering, which utilizes a thermode to press the leads against the bonding pads.

Additive Plating: A process in which the conductive, resistive, and insulating materials are successively plated to define traces, pads, and elements.

Adhesion: The state in which two surfaces are held together by means of interfacial forces.

Adhesive: A substance capable of holding materials together by surface attachment.

Adsorption: The adhesion of gases or liquid molecules to the surface of solids or liquids with which they are in contact.

Aging: The change in the properties of a material over time and under varying conditions of humidity, temperature, pressure, etc.

Alignment Holes (or Tooling Holes): Holes specifically designed in TAB tape for registration of a TAB frame. These holes can be located virtually anywhere on the tape site, however, locations are standardized in many cases.

Alloy: A metal formed by combining two or more other metals.

Analog Circuit: An electrical circuit that provides a continuous relationship between its input and output.

Anisotropic Conductive Adhesive: Conductive adhesives that conduct electricity in one direction only. Also referred to as "Z-axis conductive adhesives." When using this type of adhesive, high Z-axis forces are required during bonding. Components attached using this material use the pick, place, and attach process.

Anisotropic: A material that exhibits different properties when tested along axes in different directions.

Aqueous Cleaning: A cleaning technique that uses water as the primary cleaning fluid.

Area Array TAB: A mounting configuration for a TAB frame to an IC where the inner leads are connected to bumps in an array pattern on the surface of the IC instead of on the perimeter, which is the case for typical TAB components.

Array: A group of elements or circuits arranged in rows and columns on a substrate.

Assembly: A group of components physically joined to a PCB or ceramic board.

Automated Test Equipment: Equipment that automatically analyzes functional or static parameters to evaluate performance.

Azeotrope: A blend of two or more polar and nonpolar solvents that act as a single solvent and can be used to remove both polar and nonpolar contaminants.

Azeotropic Mixture: A liquid mixture of two or more substances that behaves as a single substance.

B-Stage PCB: Refer to "prepreg."

Ball Grid Array (BGA): A leadless surface-mountable package in which solder ball interconnects cover the bottom surface of the package in a checkboard fashion. BGAs are reflow soldered to PCBs using a mass reflow process.

Bare Board: An unpopulated PCB.

Bed-of-Nails Fixture: A test fixture consisting of a frame and holder containing a field of spring-loaded pins that make electrical contact with a planar test object.

Bend Radius: The radius at the inside of the bends at both the lead shoulder leading to the leg and the base of the leg leading to the foot.

Board: An organic printed circuit card or board on which smaller components, cards, or modules can be mounted.

Bond Strength: The force per unit area required to separate two adjacent layers of a package. The force is applied perpendicular to the surface of the package.

Bonding Alloy: A term sometimes substituted for solder. The "bonding alloy" can be application specific; the most common to fine pitch bonding is eutectic Sn/Pb solder.

Bonding Pads: Copper traces, or pads, on a substrate to which leads are bonded. Dimensions and thermal path from the bonding pads must be properly designed to achieve uniform solder reflow.

Bonding: The joining of two materials. For instance, the attachment of a component to a substrate.

Boundary Scan: An approach to the testing of printed circuit board assemblies that can be used to diagnose individual circuit failures by embedding the test circuits into the board and in the most failure-prone integrated circuits.

Built-in Lead Stress: The force within leads of a molded carrier ring or TAB component that result in lead skew or splay after the excising process. Possible causes include the dam bar removal process, the stamping process used to produce lead frames, or stress induced during prior thermal or mechanical processing of the components.

Built-In Self Test: An electrical testing technique in which hardware is added to the chip to allow the integrated circuit to test itself with minimal use of test equipment.

Bump: A small mound formed on the device or the substrate pads that can be used as a contact for face-down bonding. This is a method of providing connections to the terminal areas of a device.

Burn-In: The process in which a device is electrically stressed by subjecting it to an elevated temperature and voltage for an adequate period of time to cause the failure of a marginal device.

C-4 (Controlled Collapse Chip Connection): A solder joint connecting a substrate directly to an IC in a flip chip configuration. In this packaging scheme, a solder ball is formed on the IC, the IC is placed active circuitry down onto a

substrate, and the solder is reflowed. As the solder melts, the solder balls collapse into a shape controlled by the surface tension of the liquid solder while supporting the weight of the IC.

C-5 (Controlled Collapse Chip Carrier Connection): The same technology as C-4 except the IC is mounted in an intermediate carrier (ceramic or FR-4) using conventional technology, and the chip carrier, having the solder balls, is mounted directly to the substrate and reflowed.

C-Stage: Refer to "laminated."

Card: A printed circuit board of smaller dimensions is commonly referred to as a card. A card is generally one level lower than the printed circuit board in the hierarchy of packaging. A card is also referred to as a daughter board.

Ceramic Ball Grid Array (CBGA): A ball grid array package with a ceramic substrate.

Ceramic Column Grid Array (CCGA): The same as CBGA except the solder balls are replaced by solder columns. The advantage of columns is that the inherent flexibility of the columns help compensate for CTE mismatch between the ceramic component and the FR-4 board. Columns are required rather than solder balls for components greater than 25mm square.

Ceramic: An inorganic, nonmetallic material. Examples include alumina or glass-ceramic. Ceramics are often used in forming ceramic substrates for the packaging of semiconductor chips.

CFC: A chlorinated fluorocarbon that can cause ozone layer depletion. The use of CFCs is restricted by the Environmental Protection Agency. CFCs are primarily used in air conditioning and refrigeration, foam insulators, and cleaning solvents.

Chip Carrier: An integrated circuit package that is usually square and may possess a cavity for a chip in the center and whose connections are typically on all four sides.

Chip-on-Board (COB): A configuration in which a chip is directly attached to a printed circuit board or substrate by solder or conductive adhesives.

Chip: The individual circuit or component of a silicon wafer. The leadless form of an electronic component part, either passive or active, discrete or integrated.

Circuit: The interconnections of electrical elements and devices that perform a desired electrical function.

Clamshell Fixture: An in-circuit test fixture designed to probe both sides of a PCB.

Cleaning: An operation involving the removal of flux residues and other contaminants from the surface of a PCB assembly.

Cluster Testing: A variation of the in-circuit testing procedure in which a cluster of components are tested as a functional unit.

Coating: A thin layer of material, conductive or dielectric, applied over components or a base material.

Coefficient of Thermal Expansion (CTE): The ratio of change in dimensions to original dimensions per degree rise in temperature, expressed in ppm/°C.

Cofiring: A process for forming multilayer ceramic substrates in which thick- film conductors and dielectrics are simultaneously processed by a firing cycle.

Comb Pattern: A set of comb-like arrays of uniformly spaced conductors.

Component Lead: A wire or formed conductor that extends from a component and serves as a mechanical and/or electrical connection. Leads can readily be formed to a desired configuration.

Component: An individual functional element in a physically independent body (e.g., resistor, capacitor, or transistor).

Conduction: The thermal transmission of heat energy from a hotter region to a cooler region in the presence of a conducting medium.

Conductive Adhesive: Refer to "isotropic/anisotropic conductive adhesives."

Conductor, Electrical: A class of materials-usually metals-that easily conducts electricity. Examples include silver, copper, gold, and super-conducting ceramics.

Conductor, Thermal: A class of materials-usually metals-that easily conduct heat. Examples include copper, aluminum, and beryllia.

Conformal Coating: A thin nonconducting coating that is either plastic or inorganic and is applied to a circuit for environmental and mechanical protection.

Contact Angle: The angle between bonding material and a bonding pad. Also called the wetting angle.

Contact Printing: A type of printing where there is no gap between the stencil and the substrate.

Contact Resistance: The maximum resistance allowed between a pin and the socket contacts of a connector when assembled and in use.

Contaminant: An undesirable material that can adversely influence the properties of a material or the quality of a product. A contaminant can be liquid or solid.

Continuous Tape: A TAB tape handling scheme that uses a continuous reel of polyimide tape to mount and carry TAB components through the assembly process. Typically, the tape width conforms to industry standards, with 35mm, 48mm, and 70mm widths being the most common.

Convection: The transmission of thermal energy from a hotter region to a cooler region through a moving fluid such as air or water.

Coplanarity: The maximum distance between the lowest pin and the highest pin when a package rests on a perfectly flat surface.

Corrosion: A chemical action that causes the gradual deterioration of the surface of a metal by oxidation or chemical reaction.

Corrosive Flux: A flux that contains levels of activators like halides, amines, or organic acids that can cause the corrosion of copper.

CTE Mismatch: The difference in the coefficients of thermal expansions of two materials or components joined together, which produces strains and stresses at joining interfaces or in attachment surfaces.

Curing Cycle: The time-temperature profile needed to cure a thermosetting material like a bonding adhesive.

Curing Time: The time needed to properly cure a thermosetting plastic material.

Curing: The process of irreversibly polymerizing a thermosetting plastic by subjecting it to a temperature-time profile.

Dam Bar: A temporary part of the lead frame used to inhibit the flow of plastic during the molding process for molded carrier ring (MCR) and plastic quad flatpack (PQFP) components. The dam bar is removed prior to testing or placing the component because it is a part of the copper lead frame and thus shorts all of the leads together.

Defect: Any nonconformance to specified requirements by a unit or product.

Deionized Water: Water that has been treated to remove ionized material.

Delamination: A separation between plies within the base material, or between the base material and the conductive foil, or both.

Dendritic Growth: The metallic growth between pads in the presence of moisture and an electrical bias.

Density: The weight of a material in relationship to its volume.

Device: An individual electrical circuit element that can't be further reduced without destroying its intended function.

Dewetting: Dewetting occurs when molten solder has coated a surface and then receded, leaving mounds of solder that are irregularly shaped and are separated by areas covered with a thin solder film.

Die Bonder: The placement machine for chips in a chip-on-board process line.

Die Bonding: The attachment of an integrated circuit chip to a substrate.

Die Sorter: Equipment that picks die from a wafer and presents them for their next process step. When used in reference to bare die placement machines, the die are presented for pick by the machine's placement nozzles.

Die: Integrated circuit chip as diced or cut from the finished wafer.

Dielectric: Nonconducting material used to encapsulate circuitry and in the manufacture of capacitors and printed circuit boards.

Diffusion: A material transport phenomena that occurs in solids, and is caused by the continual physical motion of atoms from one position to another. This results in the flow of material from regions of high concentration to regions of low concentration.

Dilatant: Fluid characterized by an increase in viscosity with an increasing shear rate.

Direct Chip Attach (DCA): A chip-to-substrate connection intended to reduce the first level of packaging. Here, the silicon die is inverted and mounted directly to the PCB. Also referred to as chip-on-board technology.

Direct Chip Attach Module (DCAM): A component type developed by IBM® consisting of a small substrate with flip chips attached using the DCA process. This small substrate, or module, is now a component with solder pads on the

bottom side that can be mounted to a board using conventional surface mount processes.

Dispersants: Organic and inorganic phosphates and polymers used in aqueous cleaning to assist in the removal of insoluble particles.

Double-Sided Assembly: A fully assembled PCB with components on both sides of the substrate.

Dross Content: A measure of the cleanliness of solder powder.

Dross: Any oxide or other contamination formed on the surface of molten solder.

Dry Film Photoresist: Solid photoresist applied to a surface by lamination of prefabricated film.

Dual In-Line Package (DIP): A package with two rows of leads extending at right angles from the base with standard spacing between the leads and row. This package is intended for through hole mounting.

Dynamic Flex: A flex circuit in constant motion, for example, in a printer head.

Elastomeric: A material that at room temperature can be stretched repeatedly to at least twice its original length, and upon release of the stress, will return with force to its approximate original length. A rubber band is an example.

Electro-Deposit Copper: Copper used in manufacturing TAB tape. From a sputtered seed layer of copper, the copper is electroplated (grown) to a desired thickness, typically 1 ounce or 1.4 mils thick. The copper is usually grown on a base material, and is separated from this material upon completion of the deposition process.

Electrode: A conductor through which a current enters or leaves an electrolytic cell, vacuum tube, or any nonmetallic conductor.

Electroless Plating: Deposition of metal (without any external electric current) by an exchange reaction between metal complexes in the solution and the metal being coated.

Electrolytic Corrosion: Corrosion by means of electrochemical action.

Electromigration: The electrolytic transfer of metal from one conductor to another conductor separated from the first conductor by a dielectric medium.

Electronic Packaging: The technology of interconnecting semiconductor and other electronic devices to provide an electronic function.

Electroplating: Deposition of metal onto a cathodic surface by passing DC current into an electrolytic solution.

Emissivity: The ratio of the radiant energy emitted by a source to the radiant energy of a perfect radiating surface (black box) having an equivalent surface area with all other relevant conditions being the same.

Emulsion: A stable mixture of two or more immiscible liquids held in a suspension by small percentages of emulsifiers.

Encapsulant: The material used to cover COB devices to provide mechanical protection and to ensure reliability, typically an epoxy.

Encapsulation: The sealing or covering of an element or circuit for the purpose of mechanical and environmental protection.

Epoxy Resin: A material that forms straight chain thermoplastic and thermosetting resins. Epoxy resins have excellent mechanical properties and good dimensional stability.

Epoxy: A thermosetting polymer containing the oxirane group.

Eutectic: The minimum melting point of a combination of two or more materials. The eutectic temperature of an alloy is always lower than the melting point of any of its individual constituents. The eutectic temperature is the particular temperature at which the eutectic occurs. Eutectic alloys, when heated, transform directly from a solid to a liquid and do not show any pasty regions. For example, eutectic solder paste has a composition of 63% tin (Sn) and 37% lead (Pb), and has a eutectic temperature of 183°C.

Excising: Cutting component leads free from the remainder of the package to prepare the component for forming or placement.

Failure: The temporary or permanent functional impairment of a component or device caused by physical, mechanical, chemical, or electrical damage.

Filler Materials: Ceramic or metallic particles used to modify the properties of polymers.

Fine Pitch: Surface mount components with a lead pitch of at least 50 mils. Fine pitch is more commonly used to refer to components with a lead pitch of 25 mils

or less. These packages usually require vision assistance for accurate placement.

Flat Pack: An integrated circuit package with leads on two or four sides. The leads on these packages are either gull wing or flat, and have standard spacing. Packages with a lead pitch below 50 mils are referred to as fine pitch packages.

Flex Circuits: Flexible printed circuit boards made using thin polyimide or polyester film with copper circuitry on one or both sides of the flex. Flex circuits can be single or multilayer.

Flip Chip Attach (FCA): Refer to DCA.

Flip Chip: Any packaging scheme in which the active circuitry of an IC is placed facing the surface of the substrate. Examples are flip TAB and C-4.

Flip TAB: A mounting configuration for a TAB component where the active circuitry of the IC is placed facing the surface of the substrate.

Flux Activation Temperature: The temperature at which flux is active enough to remove oxides from the metals being joined.

Flux Activity: The efficiency of a flux to promote the wetting of a surface with molten solder.

Flux Characterization: Tests performed to determine the properties of fluxes and flux residues.

Flux Residue: A flux-related contaminant present on or near the surface of a solder connection.

Flux Solder Connection: A solder joint with entrapped flux, causing high electrical resistance.

Flux: A chemically- or physically-active formulation capable of cleaning oxides and enabling wetting of metals with solder.

Foot Angle: The angle of the lead foot after lead forming with respect to the plane defined by the bottom of the component.

Foot Length: The part of the component lead that comes in contact with the bonding pad on the substrate.

Functional Test: The electrical testing of an entire assembly that simulates the intended function of the product.

Gang Bonding: A process in which multiple mechanical or electrical bonds are made by means of a single stroke of a bonding tool.

GelPak: A matrix tray style feeder without pockets, that consists of a tacky gel over a mesh. The components are placed in a regular array on the tray and are held in place by the tacky gel. When picking components, vacuum is applied through the bottom of the tray, pulling the gel through the mesh and releasing the die.

Glass Fabric: Glass yarns woven in a specific pattern.

Glass Transition Temperature: The temperature above which a polymer loses its properties of glass and behaves as an elastomer. Glass transition temperature is characterized by a decrease in elastic modulus and an increase in CTE.

Green Strength: The strength of a substance, joint, or assembly before it has been cured.

Ground Plane: An electrically-conductive plane in a multilayer circuit that connects a number of circuit elements to grounding electrodes.

Gull Wing Lead: A lead configuration, usually found on small outline packages, where the leads are bent. The end view of these packages resembles a gull in flight.

Halide Content: The ratio of the mass of free halides to the mass of solids in a flux, expressed in mass percent of free chloride ions.

Halo: A bright or dark ring around a drop of molten solder on a flat surface.

Hermetic: The sealing of an object so it is airtight.

Hot Bar Soldering: A process in which a heated bar simultaneously solders all the leads of a device to the pads on a PCB.

Hot Gas Reflow: A solder reflow process that uses a heated gas, including air, as the mode of heat transfer.

Hydrophilic Solvent: Refer to "polar solvent."

Hydrophobic Solvent: Refer to "nonpolar solvent."

ILB Window: The opening in TAB tape where the innermost extremities of the lead are bonded to the IC.

In-Circuit Test: An electrical test of a PCB assembly in which each component is tested individually, even though many components are soldered to the PCB.

Inert Atmosphere: A gaseous atmosphere that is not conducive to chemical reactions, such as helium or nitrogen.

InfraRed (or IR) Reflow: A technique in which long wavelength light serves as the heat source to reflow solder and form solder joints.

Injection Molded Boards: Printed circuit boards made by molding filler-reinforced resins into a desired shape. Routing and through hole metallizations are performed by seeding and plating, or by printing. An alternative approach is to transfer mold the interconnect directly onto the injection molded cards.

Inner Lead Bonding (ILB): The process of attaching the IC to a TAB tape site.

Inner Lead: The innermost portion of the lead on a TAB tape site that extends into the ILB window.

Inner Ring: A strip of polyimide between the inner and outer lead bonding areas on a TAB tape site. This strip typically encircles the entire IC. It is a common feature in many TAB tape designs, but is not found in all cases.

Inorganic Flux: An aqueous flux solution of inorganic acids and halides.

Insulators: A class of materials that do not conduct electricity and are characterized by high resistivity.

Integrated Circuit: A microcircuit that consists of interconnected elements inseparably associated and formed in-situ on or within a single substrate, usually silicon, to perform an electronic circuit function.

Interconnect: The conductive path required to achieve connection from one circuit element to another.

Interconnection: The conductive path required to achieve a connection from a circuit element to the remainder of the circuit.

Interleaver: A polyester film used to protect and separate TAB tape layers. It is used whenever TAB tape or TAB components are handled in a continuous tape format.

Intermetallic Compound: An intermediate phase in an alloy system that constitutes a narrow range of composition, but has an atomic bonding that can be of several types.

Isotropic Conductive Adhesive: Isotropic adhesives conduct electricity in all directions. This means the adhesive can be dispensed only on those areas (pads) where a circuit path is required (i.e., where bumps will attach).

J-Lead: A lead configuration usually used on plastic chip carrier packages. J-leads are bent underneath the body of the package, with a side view resembling the shape of the letter "J."

Keeper Bar: A nonconductive polyimide strip located at the end of the leads to be bonded. Its purpose is to maintain lead integrity from the time the component is excised until it is bonded in place. Keeper bars are typically formed during the excising process, and are mainly found on extremely fine pitch components.

Laminate: A stack of prepregs with copper foils on either surface after lamination during PCB fabrication.

Lamination: A heat and pressure cycle used to consolidate a stack of prepregs into a solid block. The term also refers to the consolidation of a stack of laminates (with circuitry) to form a PCB. Lamination is referred to as the C-stage in PCB fabrication.

Land Pattern: The complete configuration of the lands to which a surface mount component is attached.

Land: A metallized conductor on a PCB that is designed to accept a surface mount component lead.

Laser Soldering: A method of soldering in which the heat required to reflow a solder interconnection is provided by a laser (YAG or CO₂). In this process, the solder joints are heated sequentially and cooled rapidly.

Laser: An acronym for "Light Amplification by Stimulated Emission of Radiation."

Leaching: The process during which liquid solder dissolves a metal coating.

Lead (Pb): A soft heavy gray metal used in solder and other alloys.

Lead Coplanarity: The position of all of the component leads with respect to one another using a reference plane defined by the three lowest leads of a component.

Lead Forming: After excising, forming the lead into a specific shape or profile required for placement and bonding. The typical lead form profile is a gull-wing shape.

Lead Frame: A sheet metal framework etched to form an array of metal traces (leads). An IC is attached to the lead frame at the innermost portion of the leads, and the outermost portion of the leads is attached to the next level of the assembly. However, lead frames are the basis for molded carrier ring (MCR) and plastic quad flatpack (PQFP) components, while TAB frames are the basis for TAB components.

Lead Pitch: The sum of the lead width and lead spacing. Typically stated as the distance between the center of one lead to the center of an adjacent lead.

Lead Plating: The metal coating on a component lead. Common lead plating materials are pure tin (Sn), pure gold (Au), and eutectic tin/lead solder (63% Sn/37% Pb).

Lead Spacing: The distance between adjacent leads in a defined area of a component.

Lead Thickness: In reference to component leads, it is the sum of the thickness of the base metal, plating, and total fabrication tolerances. Lead thickness is a critical element in determining the dimensions and proper clearances in excise and form tooling.

Lead Width: The width of the lead in a defined area of a component.

Lead: A wire that connects two points in a circuit; it is usually self-supporting.

Leaded Device: Electronic devices that have electrical leads extending from the body of the package.

Leadless Device: Electronic devices which do not have electrical leads extending from the body of the package. These packages could have solder bumps or lands located on the package.

Leakage Current: A small amount of current that flows through or across an insulator between two electrodes.

Leg Angle: The angle of the vertical portion of a lead with respect to a plane perpendicular to the plane defined by the bottom of the component.

Leg Length: The part of the component lead between the two bend radii. The leg length is directly related to the overall lead form height.

Melting Range: The difference between the solidus and liquidus temperature.

Mesh Porosity: The ratio of the amount of open area in a mesh versus the amount of closed area in a mesh.

Mesh Size: The number of openings per inch in a screen. For example, a 325 mesh screen has 325 openings per inch.

Metal Composition: The composition of metals in an alloy that go into solder paste.

Metal Content: The percentage weight of the solder alloy powder in solder paste.

Metal-Core Boards: Boards built with a metallic core and an organic or inorganic insulation on either sides of the core. The core could be made of steel, stainless steel, aluminum, copper, or a laminate of metals (in most cases copper invar copper or copper tungsten copper). The insulation of the core is done prior to metallization.

Metering Rolls: Successive rollers used to control the fabric to resin ratio during the impregnation of resin onto glass fabric.

Micron: One millionth of a meter, and another term for micrometer. An easy conversion scheme is to remember that $25.4 \text{ microns} = 0.0254 \text{ mm} = 0.001 \text{ inch} = 1 \text{ mil} = 1,000 \text{ microinches}$. With this formula memorized, it is simple to translate between inch and metric references.

Microstructure of Material: Atomic structure of a material. In bonding applications, refers to the effect of atomic structure on material behavior during various steps in the excise, form, and bonding processes.

Misalignment: Misregistration of the centerline of the component lead with respect to the centerline of the bonding pad on the substrate.

Misregistration: The lack of adequate dimensional conformity between two or more patterns or features. Examples include misregistration of a board with respect to a stencil or the misalignment between layers of a printed circuit board.

Mold Flash: Plastic debris remaining on a plastic molded package after the component manufacturing process. This can occur on molded carrier ring (MCR) and plastic quad pack (PQFP) components.

Molded Carrier Ring (MCR) Component: A packaging technique for ICs that utilizes a plastic molded body and guard ring. MCR were developed to reduce damage to leaded surface mount packages caused by normal handling. The guard ring also acts as a common form factor for the development of automation such as test, burn in, and excise and form.

Multichip Module: A module capable of supporting several ICs in a single package. Typically, multichip modules are based on ceramic, contain high performance ICs with high pin count, and use some form of advanced interconnect technology such as TAB, COB, or C-4. The parameters used to define a multichip module are vague, but one basic criterion is a package that is no less than 20% silicon, has no fewer than 100 I/O on a substrate, and has no fewer than four layers.

Multilayer Board: A PCB that uses more than two layers for conductor routing. Plated via holes are used to connect the internal layers to the outer layers.

Multilayer Ceramic: A stack of alternating metallic and ceramic layers with vias interconnecting them.

Multilayer Substrate: Organic substrates composed of more than one laminate. Cofired multilayer ceramic substrates are also referred to as multilayer substrates.

Multiple Metal Layer Tape: An advanced TAB tape that has more than one conductive layer. This tape design is complex, including ground planes and interconnections between conductive layers, and is only used in select high performance applications.

Neutralizer: An alkaline chemical added to water to improve its ability to dissolve organic acid flux residues.

Nitto tape: Tape that sliced silicon wafers are placed on prior to dicing.

Nonactivated: A natural or synthetic resin flux without activators.

Nonionic: Refer to "nonpolar."

Nonpolar Solvent: A solvent that is not electrically conductive and will dissolve nonpolar compounds such as hydrocarbons and resins.

Nonpolar: A condition in which a substance does not ionize in water.

Nonwetting: A condition in which molten solder has contacted a surface, but the solder has not adhered to all of the surface, and a portion of the base metal may be exposed. Nonwetting occurs when there is a barrier (intermetallic or oxide) between the two joining surfaces.

Off-Contact: A stencil printing method in which the printer is setup so there is a space between the stencil and the substrate.

OLB Window: An opening in TAB tape that the outer leads span. Typically, this opening is where outer leads are excised from the tape.

Open: A complete break in a metal conductor path.

Open: A condition in which solder fails to bridge the gap between lead termination and the pad, resulting in a loss of electrical continuity.

Organic PCB: A printed circuit board made from organic material (epoxy, polyimide, etc.).

Outer Lead Bonding: The process of joining the leads of a component to the next level of the assembly immediately following placement. Commonly referred to as OLB. The bonding method can be laser, hot gas, or hot bar.

Outer Lead: The length of lead that extends across the OLB window. It is typically excised, formed, and attached to a substrate.

Outgassing: The gaseous emission or de-aeration from a PCB or solder joint.

Over Molded Plastic Array Carrier (OMPAC™): Motorola®'s trade name for plastic ball grid array components (PBGA).

Oxide Content: The amount of oxides present on the surface of solder powder.

Packaging Density: The quantity of components, interconnections, and mechanical devices per unit volume.

Packaging Level: The various members that comprise the packaging hierarchy, such as chip, chip carrier, PCB, system, etc.

Pad: A portion of the conductive pattern that is typically used for the connection, and/or attachment of components.

Passive Hold-Down: The process of holding the component lead in contact with the bonding pad by pressing on the body of the component during the soldering process to ensure intimate contact between the lead and bonding pad. Intimate contact is important for proper heat transfer through the lead to reflow the solder. This is commonly used in laser and hot gas soldering.

PBGA (Plastic Ball Grid Array): Generic name for a BGA component constructed on organic substrate material, such as FR-4, overmolded with plastic.

PCMCIA: Personal Computer Memory Card International Association. This association was formed with the goal of promoting interchangeability of IC cards

among a variety of computer and other electronic products. Both memory and peripheral expansion (I/O) card types are defined by this standard. The cards are all 85.6mm in length and 54mm in width with a 68-pin edge connector. There are three different formats for different applications with thicknesses of 3.3mm, 5.0mm, and 10.5mm.

Peel Strength: A true test of the adhesion between the lead and the bonding pad after it has been soldered. This parameter is determined by peeling the component lead off the bonding pad using special fixturing on a pull tester.

Photolithography: The science of replicating complex circuitry onto the surface of the specimen.

Pick-and-Place: The assembly process in which components are selected and placed onto specific locations of the PCB.

Pitch: The center-to-center spacing between pads, rows of bumps, pins, etc.

Placement: The manual, semiautomatic, or automatic placement of a component, device, or chip at its intended position at a given packaging level.

Planarity: Planarity refers to substrate surface flatness. It is another term for board warpage.

Plasma Cleaning: A cleaning process that uses electrically excited gas molecules to remove surface contamination. Most commonly found in applications where extreme cleanliness is required, such as bonding pad preparation on the chip and substrate for wire bonding.

Plastic Deformation: With respect to materials science, the deformation of a material resulting from it being stressed beyond its ability to return to its original shape.

Plastic Leaded Chip Carrier (PLCC): A component package with J-leads on all four sides.

Plated Through Hole (PTH): A plated hole in a PCB used as an interconnection between the top and bottom sides or the inner layers of a PCB. PTH is intended to mount component leads in through hole technology.

Plating Inconsistency: Variance in overall lead plating thickness and cross-sectional characteristics, which can cause lead form variation during the lead forming process.

Polar Solvent: A solvent with the ability to dissolve polar compounds such as inorganic salts. However, polar solvents cannot dissolve nonpolar compounds such as resins and hydrocarbons.

Polyimide: A nonconductive polymer used as base material for two and three layer TAB tape.

Polyimides: Thermosetting ring chain polymers characterized by -NH group. They are being increasingly used as dielectrics in high performance circuits.

Polymerize: To chemically unite two or more polymers or monomers of the same kind to form a molecule with higher molecular weight.

Polymerized Rosin: Rosin that has reacted with itself during the course of a soldering operation.

Preflow: The period of time in the reflow profile after preheat and before the reflow spike occurs. During this time, the temperature of the metals being joined is allowed to equalize.

Preheat: A preliminary phase of a process during which the product is heated at a predetermined rate from the ambient temperature to a desired elevated temperature.

Preheating: Increasing the temperature of a material above the ambient temperature to reduce the thermal shock and influence the dwell time during subsequent elevated temperature processing.

Prepreg: Partially-cured fiber-reinforced resin fabric. Also referred to as the B-stage in the manufacturing of PCB.

Printed Circuit Board (PCB)/Printed Wiring Board (PWB): The term generally used for printed circuit configurations such as rigid or flexible, single, double, or multilayered boards that are completely processed. A PCB or PWB is a substrate of a glass fabric impregnated with a resin (usually epoxy) and cured and clad metal (almost always copper) upon which a pattern of conductive traces is formed to interconnect components.

Printed Wiring Assembly: Also called printed circuit assembly, this term is used for a printed wiring board in which all the individual components have been completely attached.

Probe: A rigid, pointed, metallic, wire-shaped device used for making electrical contact to a circuit pad for electrical test purposes.

Profile: A graphical representation of the time versus temperature of a continuous furnace or oven cycle.

Pseudoplastic: A fluid that displays a decrease in viscosity with an increase in the shear rate.

Pull Strength: A measure of the quality of a solder joint formed between a component lead and a bonding pad on a substrate. This parameter is typically determined by placing a hook under the shoulder of a lead and pulling up.

Quad Flat Pack (QFP): A ceramic or a plastic chip carrier in which the leads project down and away from all four sides of a square package.

Radiation: The combined process of emission, transmission, and absorption of thermal energy between bodies separated by an empty space.

Reflow Soldering: The process of joining two metallic surfaces (without the melting of base metals) attained through the heating of predeposited solder paste to subsequently form solder fillets at the metallized areas.

Reflow: The application of heat to a surface containing a thin deposit of a low melting point metal or alloy (e.g., solder paste tin lead alloy), resulting in the melting of the deposit, followed by its solidification.

Reliability: The continued conformance of a device or system to a specification over an extended period of time.

Repair: An operation that restores a part or assembly to a condition in which it can be used.

Residues: Contaminants left behind on the surface of the substrate or the PCB as a consequence of both preassembly and assembly operations.

Resin Flux: A resin and small amounts of organic activators in an organic solvent.

Resin Impregnation: The process of coating a glass fabric by resin using metering rolls to control the fabric to resin ratio.

Resin: An organic polymer which, when mixed with a curing agent, crosslinks to form a thermosetting plastic.

Resistance: The property of a material to oppose the flow of current.

Rework: A manufacturing operation that restores a part or an assembly to an operable condition. The reworked part/assembly should meet or surpass specifications.

Rheology: The study of the change in the form and flow of matter, embracing elasticity, viscosity, and plasticity.

Rolled Annealed Copper: A type of copper used in manufacturing TAB tape. The copper is passed through a series of rollers to achieve a desired thickness, typically 1 ounce or 1.4 mils thick, and then annealed to remove the internal stresses created by the rolling process.

Rosin Flux: Rosin in an organic solvent or rosin as a paste with activators.

Rosin: A hard, natural resin, consisting of abietic acid and pimaric acids and their isomers, some fatty acids, and terepene hydrocarbons. Resin is extracted from pine trees and subsequently refined.

Saponifier: An alkaline chemical added to water to improve its ability to dissolve rosin flux residues.

Screen Printing: The transfer of a pattern onto a surface by forcing a suitable material through a screen with a squeegee.

Self-Alignment: The tendency of certain slightly misaligned components (during placement) to self-align with respect to their land patterns during reflow soldering. It occurs due to the surface tension of molten solder.

Self-Planarizing Head: A mechanism integrated into the head of an outer lead bonder that allows the bottom surface of the thermode blades to adjust to the plane defined by the surface of the substrate.

Shadowing: The failure of molten solder to wet the leads of surface mount components due to their location on the board during wave soldering or the cause for insufficient heating of surface mount components due to their location on the board during infrared reflow soldering.

Shear Strength: The force required to shear apart adhesive-bonded and cured materials and/or components.

Shipping Tube: In reference to molded carrier ring or TAB components in slide carriers, it is the tube in which components are vertically stacked for shipping and feeding into excise and form feeders.

Short: An unwanted connection between conductor paths.

Single Layer TAB Tape: Tape constructed with a single conductive metal layer, typically 70 micron thick copper. This type of tape is generally used in low lead count applications, and is not commonly seen.

Single-Layer Board: A printed circuit board that contains metallized conductors on one side of the board only.

Slide Carrier: A carrier for handling singulated TAB components. The slide carrier looks and functions similarly to the outer ring of a molded carrier ring component. It serves to facilitate component test, burn-in, and mechanical registration in a set of tooling. Slide carriers come in three basic sizes, 35mm, 48mm, and 70mm.

Slump: The distance a substance (e.g., an adhesive) moves after it has been applied and cured.

Small Outline Integrated Circuit (SOIC): An integrated circuit surface mount package with two parallel rows of gull-wing leads.

Small Outline J-Leaded (SOJ): An integrated circuit surface mount package with two parallel rows of J-leads.

Small Outline Transistor (SOT): Discrete surface mount transistors with a molded plastic outline that serve small and medium power applications.

Solder Balls: Small spheres of solder adhering to the laminate, mask, or conductor surfaces usually after wave or reflow soldering.

Solder Bridging: Solder paste or solder on two or more adjacent pads that come into contact to form a conductive path (forming a bridge).

Solder Bumps: Round solder balls bonded to the pads of components and subsequently used for face-down bonding techniques.

Solder Connection: The joining of two or more metal parts by means of an electrical or mechanical connection.

Solder Mask: A dielectric material used to cover the entire surface (except where the joints are to be formed) of the PCB primarily to protect the circuitry from environmental damage. Solder mask also helps to reduce bridging.

Solder Paste: A homogenous and kinetically stable mixture of minute spherical solder particles, flux, and a vehicle system.

Solder Powder: The solder alloy in solder paste exists in the form of powder. Solder powder is the major ingredient that affects the printability of the paste and the quality of the solder joint.

Solder Thickness: The amount of solder deposited on a pad for reflow. Optimum thickness will vary with pad size and pitch, but must be consistent across a single bonding site.

Solder Wicking: The capillary movement of molten solder onto a pad or component lead or between metal surfaces, such as strands of wire.

Solder: A low melting point alloy, usually of lead (Pb) and tin (Sn), that can wet copper, conduct current, and mechanically join conductors.

Solderability: The ability of a conductor to be wetted by solder and to form a strong bond with the solder.

Soldering: A process of joining metallic surfaces with solder, without melting the base material.

Solids Content: The metal powder content as a percentage of the mass of the wet solder paste.

Solvent Cleaning: A cleaning method employing chlorinated and fluorinated hydrocarbon liquids.

Solvent Extraction: The removal of one or more components from a liquid mixture by intimate contact with a secondary liquid that is nearly insoluble in the first liquid and which dissolves the impurities and not the substance to be purified.

Solvent: A solution capable of dissolving a solute.

Specific Heat: The ratio of a material's thermal capacity to that of water at 15°C.

Spherically Compliant Suspension: A patented mechanism based on a four-bar linkage that can be integrated into an outer lead bonder to have self-planarization of the thermode head to the substrate. This mechanism has been developed and patented by Universal Instruments Corporation.

Splice: A strip of material used to join two pieces of tape. Splices are used to connect strips of TAB tape when handled in continuous tape format.

Spread: The distance a substance (e.g., an adhesive) moves after it has been applied at ambient conditions.

Sprocket Holes: Holes along both edges of TAB tape used for handling, indexing, and in some cases, registration.

Sprocket Pitch: The center to center distance of two adjacent sprocket holes.

Static Flex: Flex circuits that are bent during installation, but do not undergo any further movement in an assembly.

Stencil Printing: Deposition of a specific material, such as solder paste, using a stencil.

Stencil: A metal mask in which patterns or apertures matching the component locations on the PCB are made so a suitable material can be forced through the apertures by a squeegee onto a substrate.

Stress Corrosion: The gradual deterioration of the mechanical properties of a material, usually accompanied by crack propagation, and caused by the acceleration of applied stress. This phenomenon usually occurs under high humidity conditions.

Substrate Geometry: Substrate dimensions, typically dimensions critical to implement a successful bonding process, including the following: board size, bonding pad layout and dimensions, solder thickness, adjacent components, planarity, fiducial shape and dimensions, and board thickness and construction.

Surface Insulation Resistance (SIR): The electrical resistance of an insulating material between a pair of contacts or conductors. SIR is determined under specified environmental and electrical conditions.

Surface Mount Technology: A method of assembling printed circuit boards where the components are mounted onto the surface of the board rather than being inserted into holes in the board.

Surface Tension: An effect of the forces of attraction between the molecules on the surface of a liquid. Surface tension is the reason water beads up better on the hood of your car when waxed versus unwaxed. The wax increases the surface tension of the water, and thus it beads up more readily.

Surfactant: A chemical added to any substance to lower its surface tension.

Surftape: A punched carrier for tape and reel packaging of surface mount devices. It features a flexible, pressure-sensitive adhesive base, negating the need for cover tape.

Suspension Brake: A pneumatic clamp on the spherically compliant suspension which can be used to lock the head in a given orientation.

TAB Component: An IC mounted on a TAB site.

TAB Tape Site or TAB Frame: An individual component mounting site on TAB tape.

TAB Tape: A polymer film with patterned metal traces or leads. It is only a temporary support that is almost completely removed during the transfer of the chip from the tape to the substrate. The TAB tape can be handled in continuous tape or slide carrier format.

Tackiness: The ability of solder paste to hold surface mount components in place after placement but before reflow soldering.

Tape Automated Bonding (TAB): The process where silicon chips are joined to patterned metal traces (leads) on polymer tape to form inner leads bonds and subsequently the leads are attached to the next level of the assembly, typically a substrate or board, to form outer lead bonds. TAB is the technique of interconnecting silicon with beam bonding as opposed to wire bonding.

Tape Bonding: Utilization of a metal or plastic tape material as a support to a carrier of a component in a gang bonding process.

Tape Ball Grid Array (TBGA): A BGA package on a copper polyimide base like TAB, except TAB leads are replaced by an area array ball grid for interconnects. A stiffener is added to ensure flatness for the mass reflow assembly process.

Terminal: A metallic device used for making electrical connections.

Test Board: A printed circuit board deemed to be suitable for determining the acceptability of a group of boards produced with the same fabrication process.

Test Fixture: A device that interfaces between test equipment and the unit being tested.

Test Pads: Contact points on TAB tape, located outside the OLB window, that are used to facilitate testing and burn-in of the IC while it is in the TAB frame. Test pads remain with the discarded portion of the carrier after excising.

Test Pattern: A pattern used for inspecting or testing purposes.

Test Point: A specific point of access to an electrical circuit used for electrical testing purposes.

Thermal Conductivity: The property of a material that describes the rate at which heat will be conducted through a unit area of the material for a given period of time.

Thermal Cycling: A method used to induce stresses on electrical components by means of sequential heating and cooling in an oven. It is used in accelerated reliability testing.

Thermal Profile: A time versus temperature graph that displays the temperatures an assembly is subjected to over time in an oven during processes such as reflow soldering or the curing of adhesives, encapsulants, and conformal coatings.

Thermocompression Bonding: The joining of two materials without an intermediate material by the application of pressure and heat in the absence of electrical current.

Thermode: A set of blades or bars that are pulse-heated. A thermode is used to hold component leads in place and reflow solder them to bonding pads on a substrate during hot bar reflow soldering.

Thermoplastic: Polymer materials that can be repeatedly melted without significant change in their properties.

Thermosetting Plastic: Polymer materials that cure (irreversibly polymerize) at specific temperature and time conditions.

Thixotropic Ratio: An indication of thixotropy as a ratio of viscosities at two different shear rates.

Three Layer TAB Tape: Tape constructed with a conductive metal layer, typically 35 micron thick copper; a flexible heat resistant support layer, typically 125 micron thick polyimide; and an adhesive layer between the conductive layer and the flexible support layer. The polyimide thickness is not limited in the three layer tape manufacturing process because the openings in the tape are punched out rather than etched. The copper is usually tin or gold plated.

Threshold Limit Value: A guideline for the exposure of humans to solvents; it is expressed as a Time Weighted Average (TWA) of the parts per million of vapor in air.

Through Hole: A hole connecting the two surfaces of a printed circuit structure.

Tie Bars: Polyimide strips, or bars, connecting an inner ring at its corners to the remainder of the TAB tape site. Also referred to as suspenders.

Tinning: The process of coating metallic surfaces with a thin layer of solder.

Tip-to-Tip Dimension: With respect to component geometry, the distance between the ends of the leads on opposite sides of a component after excising and forming.

Tombstoning: The lifting of one end of a passive surface mount component during solder reflow caused by surface tension and unbalanced forces of solder wetting.

Torsional Strength: The torque required to separate adhesive bonded (and cured) materials and/or components.

Touch-Up: The identification and elimination of defects in a product.

Transistor: An active semiconductor device capable of providing power amplification. Transistors have three or more terminals.

Two Layer TAB Tape: This tape is constructed with a conductive metal layer, typically 35 micron thick copper, and a flexible heat resistant support layer, typically 50 micron thick polyimide. The support layer thickness is limited to 50 microns or less due to chemical etching limitations of the two layer TAB tape manufacturing process. The copper is usually tin or gold plated.

Type I Assembly: A surface mount assembly with surface mount components on one or both sides of the substrate.

Type II Assembly: A surface mount assembly with surface mount components on one or both sides of the substrate and through hole devices on the primary side.

Type III Assembly: A surface mount assembly with surface mount components on the secondary side of a PCB and through hole devices on the primary side.

Ultrasonic Cleaning: The use of ultrasonic energy along with a chemical solvent to clean a component or a PCB assembly immersed in solvent. Mechanical oscillation is introduced by the ultrasonic energy to facilitate cleaning.

Underfill: In flip chip applications, the material injected under the die after testing to ensure reliability. This material is particularly important for flip chips mounted on substrates with different CTEs than silicon, such as FR-4 and some ceramics.

Vapor Phase Reflow: A solder reflow technique in which the solder joints are heated by the condensation of an inert vapor.

Vehicle System: The vehicle dissolves flux and imparts paste-like characteristics to solder paste.

Vias: Drilled holes in laminate that interconnect different layers of circuitry. Vias can be used for electrical connections or thermal dissipation.

Void: A hole or bubble in a solder joint.

Waffle Pack: A matrix tray for holding bare die. Typically, waffle packs are 2" x 2" or 4" x 4." The pockets for die in waffle packs are typically designed for specific die sizes; they are not standardized.

Wave Cleaning: Cleaning a PCB by passing it through a wave of solvents (similar to the concept used in a wave fluxer or a wave soldering process).

Wave Soldering: A process in which many potential solder joints are brought in contact with a wave of molten solder for a short period of time and are soldered simultaneously.

Wetting Balance: An instrument used to measure wetting forces, and consequently, estimate solderability.

Wetting: The spreading of solder along the leads and pad to produce complete and uniform solder coverage.

Whisker: A metallic growth, needle-like in size, that appears on the surface of a PCB.

Wire Bonding: The use of fine wires to connect semiconductor packages to the next level of packaging. Wires are composed of gold or aluminum.

Z-Axis Conductive Epoxy: Refer to anisotropic conductive adhesive.