Aeroflex-Plainview

Microelectronics Glossary

A

Abrading Equipment
This type of equipment fires a gas propelled stream of finely graded abrasive particles through a precise nozzle against the work surface. When linked to abrading equipment, it can cut intricate patterns in silicon semiconductors.

Absolute maximum ratings
The range of voltages, currents, temperatures, etc., outside of which the devices performance or reliability is expected to seriously degrade or the device will cease to function. Unless otherwise specified, these ratings are given for T_A = + 25°C. Combinations of maximum ratings may not be applied simultaneously.

Accept number
The maximum number of devices which may fail a sample test without causing rejection of the lot.

Acceptor
An impurity that can make a semiconductor P-type by accepting valence electrons, thereby leaving "holes" in the valence band of the semiconductor device. The holes act like carriers of positive charge.

Activating
A treatment which renders nonconductive material receptive to electroless deposition.

Active circuit area
That area of a die or a hybrid substrate which contains all functional circuit elements, operating metallization or any connected combinations thereof, excluding beam leads.

Active components
Electronic components, such as transistors, diodes, thyristors, etc., which can operate on an applied electrical signal so as to change its basic character; i.e., rectification, amplification, switching, etc.

Active device
An electrical element capable of modifying an input voltage in such a way as to achieve rectification, amplification, or switching action, e.g., transistors.

Active devices
Discrete devices such as diodes or transistors; or integrated devices, such as analog or digital circuits in monolithic or hybrid form.

Active element
An element of a circuit in which an electrical input signal is converted into an output signal by the nonlinear voltage/current relationships of a semiconductor device (see Active Components).

Active network
A network containing active and passive elements.

Active substrate
A substrate for an integrated component in which parts display transistance. Examples are single crystals of semiconductor materials, within which transistors and diodes are formed.

Active trim
Trimming of a circuit element (usually resistors) in a circuit that is electrically activated and operating to obtain a specified functional output for the circuit (see Functional Trimming).

A-D converter
Analog-to-digital converter; a circuit which accepts information in a continuously varying a-c or d-c current or voltage and whose output is the same information in digital form.

Add-on component
Discrete or integrated prepackaged or chip components that are attached to a film circuit to complete the circuit functions.

Add-on device
Same as Add-On Component.

Adhesion
The property of one material to remain attached to another; a measure of the bonding strength of the interface between film deposit and the surface which receives the deposit; the surface receiving the deposit may be another film or substrate.

Alloy
A solid state solution of two or more metals. (v.) To melt or make an alloy.

Alloying
The step in the fabrication process immediately following evaporation. This process alloys the conductive metal which had bow deposited on the die surface to that surface, thus providing ohmic contact with the active circuit elements.

Alloy junction
A junction produced by alloying one or more impurity metals to a semiconductor. A small button of impurity metal is placed at each desired location on the semiconductor wafer, heated above its melting point, and cooled. The impurity metal alloys with the semiconductor material to form a p or n region, pending on the impurity used.

Alpha particles
Helium nuclei emitted as a result of the radioactive decay of trace amounts of naturally occurring uranium and thorium found In semiconductor packaging materials. Alpha particles, if not properly controlled, can cause soft errors in dynamic memories.

Alternate print
In screen printing, one squeegee print stroke per substrate in alternate directions.

Alumina
Aluminum oxide (A12O3) used as a ceramic substrate material.

Align
To put into proper relative position, agreement, or coordination when placing parts of a photomask together or placing a photomask over an etched pattern in the oxide on a semiconductor wafer.

Alignment
The accuracy of coordination or relative position of images on a semiconductor oxide coating and on the photomask, or any other images placed in relation to those.

Ambient temperature
Temperature of atmosphere in intimate contact with the electrical part or device.

Analog circuits
Circuits that provide a continuous (versus discontinuous) relationship between the input and output.

AND-gate
Gate whose output is energized only when every input is in its prescribed state. An AND gate performs the function of the logical "AND". Also called AND-circuit.

Angle of attack
In screen printing, angle at which the squeegee blade attacks the screen surface.

Angled bond
Bond impression of first and second bond are not in a straight line.

Angstroms (Å)
A unit of measurement used in thin film circuits equal to 10^{-10}m. (1 micron = 10,000 Å)

Annealing
Heating of a film resistor followed by slow cooling to relieve stresses and stabilize the resistor material.

Anodization
An electrochemical oxidation process used to change the value of thin film resistors or prepare capacitor dielectrics.

AOQL
Average Outgoing Quality Level - The maximum acceptable reject percentage on the average for all outgoing lots.

AQL
Acceptable Quality Level - The maximum percent defective that can be considered acceptable as an average for all lots screened. The sample size used with a given AQL will prevent acceptance of 95% of all lots having a greater percent defective.

Architecture
The functional design of a complex component, circuit or system, including both its hardware and its compatibility with external hardware and software.

Array
The group of patterns on a wafer or in the artwork or photomask for semiconductor processing.

Artwork
The original pattern or configuration produced at an enlarged ratio, from which a circuit product is made, using a technique of photographic reduction to achieve microelectronic scale; layouts and photographic films created to produce thick film screens and thin film masks.

As-fired
Description of properties of ceramic substrates (smoothness) or thick film resistors (values) as they emerge from furnace processing, before any trimming or polishing.

ASIC
Application Specific Integrated Circuit - A custom or semicustom integrated circuit, such as a cell or gate array, created for a specific application. The complexity of ASIC typically requires significant use of CAD techniques.

Aspect ratio
The ratio between the length of a film resistor and its width; equal to the number of squares of the resistor.

Assembly
A film circuit to which discrete components have been attached. Also an assembly of one or more film circuits which may include several components.

Assembly drawing
A drawing showing all the components and interconnections mounted or soldered to the film circuit in their proper position. It might also show the assembly of one or more film circuits which may include several discrete components.

ATP
Acceptance Test Plan - A document developed for the purpose of detailing all of the testing involved in device and/or lot acceptance.

Attack angle
See Angle of Attack.

Attributes data
Gross quantitative data indicating the total number of devices subjected to and passing or failing the various screening steps in a test sequence.

Audit
Random surveillance of processes, specifications, etc.

Au/Ge
A solder of gold and germanium, usually in 88/12 ratio, for higher-temperature substrate and die attach.

Au/Sn
Chemical notation for gold/tin, usually in the ratio of 80%/20%, a type of solder used for sealing gold-plated packages.

Axial leads
Leads coming out of the ends of a discrete component or device along the central axis rather than out the sides.

Axis
A plane through a device established for the purpose of orienting the application of force during such stresses as constant acceleration. The most widely used axis is the Y1 axis, in which the application of force is such that it will tend to lift the die off the mounting surface or the wires off the die.

B

Back bonding
Bonding active chips to the substrate using the back of the chip, leaving the face with its circuitry face up. The opposite is face down bonding.

Back end
A slang term frequently applied to the assembly and test portion of the semiconductor manufacturing process. See Front end.

Back mounting
See Back Bonding.

Back radius
The radius of the trailing edge of a bonding tool foot.

Backfill
Filling an evacuated hybrid circuit package with a dry inert gas prior to hermetically sealing.

Backlapping
Fine grinding or polishing on the bottom side of wafers prior to diffusion to reduce wafer stress and provide uniform thickness and planarity.

Backside abrasion
A process whereby the backside of a finished wafer is cleaned using a fine-granular powder under air pressure in order to remove all oxidation or any other materials. The resulting level of wafer cleanliness allows better die attach of dice from the wafer.

Bake-out
Elevated temperature process which evaporates unwanted glass and moisture before final sealing of a hybrid circuit package.

Ball bond
Type of thermocompression bond wherein a ball shaped end interconnect wire is flattened against a metallized pad.

Ball bonding
Normally employed with gold wire, ball bonding employs a bonding head which compresses the end of the wire under high heat to flatten it onto a large area of the bonding pad. The term is derived from the round appearance of the bond when viewed from above. Ball bonding is frequently employed with small geometry die (such as transistors), since a l mil ball bond of 1 mil wire can be accomplished with a 2.5 mil circular bond width, whereas an ultrasonic bond will typically be rectangular shaped 4 mil in length by 1.2 mils in width. When ball bonding is employed, the opposite of the wire will often be stitch bonded, since it is difficult to ball bond at both terminals.

Barium titanate (BaTi03)
The basic raw material used to make high dielectric constant ceramic capacitors. Used also in high K thick film ceramic pastes.

Baseline
A detailed definition of a device's electrical and mechanical configuration, assembly, processing and testing used as a base from which to track subsequent changes.

Batch processing
Manufacturing method whereby a particular process sequence operates on a large number of components simultaneously.

Bathtub package
A box-like package wherein the substrate is mounted.

Beam lead device
An active or passive chip component possessing beam leads as its primary interconnection and mechanical attachment means to a substrate.

Beam leads
A generic term describing a system in which flat, metallic leads extend beyond the edges of a chip component, much the same as wooden beams extend from a roof overhang. These are used to interconnect the component to film circuitry.

Beryllia
Beryllium oxide ceramics (BeO) significant in that they have high thermal conductivity characteristics.

Bimetallic contamination
A corrosion that results from the interaction of gold with aluminum that contains more than 2% silicon. At temperatures greater than 167°C, the silicon will act as a catalyst to create an aluminum-gold alloy. The resulting metallic migration results in gaps (called Kirkendall voids) in the gold-aluminum interface. Bimetallic contamination can decrease bond wire adhesion and can lower current carrying capability at the interface. In extreme cases, bond wires will actually lift from the pad. Bimetallic contamination is frequently referred to as "purple plague."

Binary logic
Logic using two logic states (ON and OFF, or Logic "0" and Logic "1 ").

Binders
Substances added to unfired substrates and thick film compounds to add strength.

Bit
One binary digit. In binary arithmetic all data is represented by 1's and 0's. In a semiconductor device, these logic levels are created by the presence or absence of electrons in a cell.

BIT
See Built-in test.

Bipolar transistor
Transistor that uses both negative and positive charge carriers.

Bleeding
In photomasking, poor edge definition or acuity caused by spread of image onto adjacent areas.

Blending
Different viscosities of the same type of materials may be blended together to achieve intermediate viscosities. This term also is applied to resistive inks that can be blended with each other to achieve intermediate resistivities.

Blister
A lump or raised section of a conductor or resistor caused by out-gassing of the binder or vehicle during firing. An uplifting of the primary or secondary plating on a package.

Boat
A container for materials to be evaporated or fired.

Block
To plug up open mesh in a screen to prevent resistor and conductor pastes from being deposited in unwanted areas.

Block diagram
A circuit diagram in which the essential units of the functional system are drawn in the form of blocks and the relationship between blocks is indicated by appropriate connecting lines.

Block off
See Block.

Bomb
A chamber for pressurizing or depressurizing packages.

Bond
An interconnection which performs a permanent electrical and/or mechanical function.

Bond deformation
The change in the form of the lead produced by the bonding tool, causing plastic flow, in making the bond.

Bond envelope
The range of bonding parameters over which acceptable bonds may be formed.

Bond interface
The interface between the lead and the material to which it was bonded on the substrate.

Bond liftoff
The failure mode whereby the bonded lead separates from the surface to which it was bonded.

Bond off
An extra bond attached to the edge of the post or land area of a package (but never to the bonding pad on the die) for the purpose of clearing the bonding machine. See Bond Liftoff.

Bond pad
See Bonding Area.

Bond parameters
See Bond Schedule.

Bond pull
Pulling of the bond wires to destruction to determine the strength of the bonds. See MIL-STD-883, Method 2011. See also Nondestructive bond pull .

Bond schedule
The values of the bonding machine parameters used when adjusting for bonding. For example, in ultrasonic bonding, the values of the bonding force, time, and ultrasonic power.

Bond site
The portion of the bonding areas where the actual bonding took place (see Bonding Area).

Bond strength
A measure of force or pressure required to separate a layer of material from its base. This may be measured as peel strength, in pounds per inch of width, or as pull strength, in pounds per square inch, when a perpendicular pull is applied to the surface of the material. Frequently used to refer to wire bonds.

Bond surface
See Bonding Area.

Bondability
Those surface characteristics and conditions of cleanliness of a bonding area which must exist in order to provide a capability for successfully bonding an interconnection material by one of several methods such as ultrasonic or thermocompression wire bonding.

Bond-to-bond distance
The distance measured from the bonding site on the die to the bond impression on the post, substrate land, or fingers which must be bridged by a bonding wire or ribbon.

Bond-to-chip distance
In beam lead bonding, the distance from the heel of the bond to the component.

Bond tool
The instrument used to position the lead(s) over the desired bonding area and impart sufficient energy to the lead(s) to form a bond.

Bonding, die
Attaching the semiconductor chip to the substrate, either with an epoxy, eutectic or solder alloy.

Bonding area
The area, defined by the extent of a metallization land or the top surface of the terminal, to which a lead is or is to be bonded.

Bonding island
Same as Bonding Pad.

Bonding pad
A metallized area at the end of a thin metallic strip or on a semiconductor to which a connection is made. An expanded metallization area on the surface of a die where the bonding wire will be placed. Also called Bonding Island.

Bonding ribbon and tape
Bonding ribbon and tape are used in the manufacture of high-volume IC's such as memory devices and consumer products. Wire connections between I/O pads on the circuit die and the lead frame are replaced by a piece of tape with finely etched fingers that are patterned to fit exactly onto the pads.

Bonding wire
Fine gold or aluminum wire for making electrical connections in hybrid circuits between various bonding pads on the semiconductor device substrate and device terminals or substrate lands.

Bottom-brazed flat
A flat package with the leads brazed to feedthroughs on the bottom of the package rather than passing through the package side.

Borosillcate glass
A sealing glass providing a close coefficient of expansion match between some metal leads and ceramic or glass packages.

Boss
Slang for "pedestal"; see that entry. Or see illustration for alternate definition.

Braze
A joint formed by a brazing alloy (v.). To join metals with a non-ferrous filter metal at temperatures above 800°F.

Brazing
Similar to soldering. The joining of metals with a non-ferrous filler metal at temperatures above 800°F. Also called hard soldering. The process of joining two or more metals by partial fusion with a layer of hard soldering alloy, at high temperatures, ranging from 450°C, to above 1,500°C. The process is sometimes called "hard soldering", to distinguish it from ordinary soft soldering, which uses easily fusible alloys and much lower temperatures, typically about 200°C.

Break load
See Bond Strength.

Breakaway
In screen printing, the distance between the upper surface of the substrate and the lower surface of the screen when the screen is not deflected by the squeegee.

Breakdown voltage
Voltage at which an insulator is dielectric ruptures, or at which ionization and conduction take place in a gas or vapor. Of a semiconductor diode, the voltage measured at a specified current in the breakdown region.

Bubble memories
In general, magnetic bubble memory systems consist of a film deposited on a garnet substrate. Data is stored in magnetic domains (bubbles) which are formed on the film by the application of a perpendicular magnetic field.

Bubble test
This is a gross leak check, usually performed on a sealed package. The package is pressurized in a "bomb" for a period of time and is then placed in a hot non-viscous fluid, usually a fluorocarbon. The heat causes the gaseous contents of the package to expand. A relatively large leak is revealed by a stream of bubbles. The ultimate sensitivity is approximately 1×10^{-10} cc of helium.

Bugging height
The distance between the hybrid substrate and the lower surface of the beam lead device which occurs because of deformation of beam leads during beam lead bonding.

Built-In test
Subcircuitry designed into a circuit to allow that circuit to test itself either at a predetermined interval or upon external command.

Bulk CMOS
Conventional CMOS integrated circuit processes, so called because they are diffused into bulk silicon rather than on a substrate such as sapphire.

Bulk Conductance
Conductance between two points of a homogeneous material.

Bulk Impurities
Random impurities of uncontrolled location and density present in the bulk silicon of the wafer prior to the diffusion processes. Bulk impurities are of concern because of the growth of the various oxide layers employed during the diffusion process can result in impurity relocations and concentrations. Concentrated impurities (which are typically oxygen, carbon or sulphur) can create unwanted parasitics or various types of latent defects that can lead to premature failure.

Bump chip
A chip that has on its termination pads a bump of solder or other bonding material that is used the bond the chip to external contacts.

Bump contact
A large area contact used for alloying directly to the substrate of a chip, for mounting or interconnecting purposes.

Burn-in

Operation of electronic components often at elevated temperature, prior to their ultimate application in order to stabilized their characteristics and to identify their early failures. Also application of electrical biases to a device while operating it at an elevated temperature (usually 125°C), normally as a 100% screening test. Standard burn-in durations are 160 hours minimum for Class H devices and 240 hours for Class K. This test is designed to "weed out" devices subject to infant mortality or excessive parametric drift. See MIL-STD-883, Method 1015.

Burn-in, dynamic

High temp test with device(s) subject to actual or simulated operating conditions.

Burn-in, static

High temp test with device(s) subjected to unvarying voltage rather than to operating conditions; either forward or reverse bias.

Burn-off

See Flame Off.

Burst radiation

Large amounts of rapid dose rate ionizing radiation [normally in excess of 10^8 rads (Si)/sec resulting in device latch-up, data upset, threshold shift or other performance degradation. Burst radiation is usually associated with nuclear weapon detonation or space applications.

Butt welding

A method of joining the ends of two pieces of metal without overlapping and without brazing.

C

CAE
Computer assisted engineering. The use of software which performs engineering calculations, design, or design simulation.

CAD
Computer Aided Design. The use of computer automation in the implementation of all or a portion of a design for a complex circuit.

CAM
Computer Aided Manufacturing. The use of computer automation for all or a portion of the assembly process for a product.

Camber
A term that describes the amount of overall warpage present in a substrate.

Candidate device
A term used by military specifications to designate a device which has been or will be a specified test or screening flow but has not yet successfully completed that testing.

Capacitive decoupling
Protection of a device from voltage transients or "spikes", or the isolation of a device from an AC voltage by decoupling the voltage source(s) to ground through a capacitor.

Capacitance density
(Also referred to as Sheet Capacity) A term used to describe the amount of capacitance available per unit area (pF/mil^2 or $\mu F/in^2$).

Capillary
A hollow bonding tool used to guide the bonding wire and to apply pressure to the wire during the bonding cycle.

Capillary tool
A tool used in bonding where the wire is fed to the bonding surface of the tool through a bore located along the long axis of the tool.

Carbon boat
A machined piece of carbon which holds component parts in place during brazing or glass sealing.

Carriage
Mechanism on a screen printer to which the workholder is attached, which conveys the substrate to and from the print position.

Carriers
Holders for electronic parts and devices which facilitate handling during processing, production, imprinting, or testing operations and protect such parts under transport.

Catalyst
Any substance which affects the rate of chemical reaction, but which itself may be recovered unchanged at the end of the reaction.

Cavity device
A semiconductor device containing an internal cavity (as opposed to a molded device).

Cell array
An integrated circuit formed through the positioning and interconnection of a number of functional blocks, or cells, on a die.

Centralized processing
In digital data systems, a system which utilizes a single large processor, normally in multiprocessing or multiprogramming modes, to perform all required system computations.

Center Line Average (CLA)
The arithmetical average (AA) of measured deviations in a surface profile from an imaginary mean centerline located between the peaks and valleys. The RMS reading for a given surface finish is about 11% higher than the AA reading

Centerwire break
The failure mode in a wire pull test where the wire fractures at approximately mid- span

Centrifuge
Testing the integrity of bonds in a hybrid circuit by spinning the circuit at a high rate of speed thereby imparting a high "g" loading on the interconnecting wire bonds and bonded elements.

Ceramic
Non-metallic and inorganic material (e.g. alumina, beryllia, or steatite) used in microelectronic substrates and component parts.

Ceramic package
Alumina is generally used in making ceramic packages, because it is easier to handle and less expensive than beryllia. Preforms of ceramic are pressed or stamped out of tape and conductive patterns of metallization are screened onto the preforms. Component parts are then stacked up and fired together. External leads, usually of Kovar, have to be brazed on. The chief advantage of the ceramic package over the glass package is its significantly greater thermal conductivity. The chief disadvantages are that large tolerances on dimensions are needed because of shrinkage during firing, and it is difficult to achieve flatness because of warpage during firing.

Cerdip
Ceramic dual-in-line package with a glass seal. The conventional metal dual-in-line and the side-brazed dips both have a solder seal.

Cermet
A combination of ceramic and metal powders used for thin and thick film resistors.

Cerpac
Ceramic flat package with a glass seal. (The conventional metal flat package and the bottom-brazed flat pack have solder seals.)

Certificate of conformance (C of C)
A certificate provided by a manufacturer's QA department to the procuring activity with a lot of material to confirm that all material in the lot conforms with all applicable specifications.

Chamber
In screen printing, a slight rise or curve in the surface of the substrate.

Change control
See Configuration control.

Channel
A region of surface conduction opposite in type from that expected from the bulk doping. Channels are sometimes introduced unintentionally by surface ionic contamination. The type of channel (P or N) will be determined by the type of majority carrier introduced into the channel.

Characterization
Electrical testing performed for the purpose of determining typical device performance characteristics and/or parametric limits.

Charge carrier
A carrier of electrical charge within the crystal of a solid state device, such as an electron or a hole.

Chemical Vapor Deposition
Depositing circuit elements on a substrate by chemical reduction of a vapor on contact with the substrate.

Chessman
The disk, knob, or lever used to manually control the position of the bonding tool with respect to the substrate.

Chip
Shaped and processed semiconductor die that is mounted on a substrate to form a transistor, diode, or other semiconductor device.

Chip and wire
A hybrid technology exclusively employing face-up-bonded chip devices interconnected to the substrate conventionally, i.e., by flying wires.

Chip architecture
The design or structure of an IC chip, incorporating arithmetic logic unit, registers, and control-bus pathway configuration.

Chip capacitors
The design or structure of an IC chip, incorporating arithmetic logic unit, registers, and control-bus pathway configuration.

Chip carrier
A leadless package used in the construction of both hybrids and boards. The chip carrier has a body configuration similar to a flat pack, but electrical connection is made through contacts on the package base rather than through conventional leads.

Chip component
An unpackaged circuit element (active or passive) for use in hybrid microelectronics. Besides IC's, the term includes diodes, transistors, resistors, and capacitors

Chip-outs
Semiconductor die defects where fragments of silicon on the face have been chipped off in processing, leaving an active junction exposed.

Chisel
A special shaped bonding tool in the shape of a chisel used for wedge bonding and ultrasonic bonding of aluminum or gold wires to elements or package leads.

Chlorinated Hydrocarbon Solvents
See Halogenated Hydrocarbon Solvents.

Chopped bond
Those bonds with excessive deformation such that the strength of the bond is greatly reduced.

Chuck
Portion of the bonding machine that holds the unit to be bonded.

Circuit
The interconnection of a number of devices in one or more closed paths to perform a desired electrical or electronic function

Class 10, 100, etc.
See Particle count.

Clean room
A work station or processing area in which steps are taken (i.e. air filtering) to protect incomplete circuits from dust and contamination.

Clearance
The shortest distance between the outer edges of images applied in sequence.

Clinch
A method of mechanically securing components prior to soldering, by bending that portion of the component lead that extends beyond the lip of the mounting hole, against a pad area.

CMOS
Complementary metal-oxide semiconductor. Device febricated by the combination of a PMOS and an NMOS (P-type and N-type channel semiconductors) on the same die.

Coefficient
The ratio of change under specified conditions of temperature, length, etc.

Coefficient of Thermal Expansion
The ratio of the change in length to the change in temperature. The measurement (inch/ÚC or ppm/ÚC) of the rate at which a given material will expand or contract as the temperature changes. Where two materials with different rates of thermal expansion are joined, expansion or contraction will strain the bond interface between them. Continual straining of that bond could result in separation.

Co-fire or Cofire
To place thick film circuit patterns onto an unfired ceramic (green ceramic) and fire both circuits patterns and ceramic simultaneously as in HTCC (High Temperature Cofired Ceramics) or LTCC (Low Temperature Cofired Ceramic).

Co-firing or Cofiring
Processing dried thick film conductors, and resistors (or dielectrics and conductors or any other combination) through the firing cycle at the same time.

Coined
A screen which contains the impression of a substrate because it has been subject to abuse is said to be coined. The term coined can also refer to a screen manufactured with a coined impression for the purpose of screening media in a special designed substrate with a cavity that standard screens cannot achieve. It is also used to describe the process by which the base of a package has been formed.

Coining
A metal forming process similar to stamping except that the metal is cold flowed in addition to being sheared. Usually done in very heavy presses at speeds slower than used in stamping.

Cold Solder Connection
A soldered connection where the surfaces being bonded moved relative to one another while the solder was solidifying, causing an uneven solidification structure which may contain microcracks. Such cold joints are usually dull and grainy in appearance.

Coldweld
Forming a hermetic seal in a metal package by welding the lid to the frame using pressure alone.

Collector electrode
The metallized bonding pad making ohmic contact with the collector of a transistor element.

Collector junction
Of a transistor, a junction normally biased in the high-resistance direction, through which the current can be controlled by the introduction of minority.

Collocator
Device used to collect substrates from a screen printer and deposit them, in rows, onto a conveyor/dryer or furnace belt.

Comb pattern
A test pattern formed on a substrate in the form of a comb.

Compatible
Materials that can be mixed or blended or brought into contact with each other with minimum reaction or separation taking place; or each material added will not degenerate the performance of the whole.

Compensation circuit
A circuit which alters the functioning of another circuit to which applied with the goal of achieving a desired performance; temperature and frequency compensation are the most common.

Compensation network
Same as Compensation Circuit.

Complex arrays
An array of integrated devices in which a large number of elements are integral to each device.

Complex hybrids
A hybrid having an inner seal perimeter (that is, cavity perimeter) of greater than 2 inches (as defined in MIL-STD-883, Method 5008).

Compliant bond
A bond which uses an elastically and/or plastically deformable member to import the required energy to the lead.

Compliant member
The elastically and/or plastically deformable medium which is used to impart the required energy to the lead(s) when forming a compliant bond.

Component
A packaged functional unit consisting of one or more circuits made up of devices, which (in turn) may be part of an operating system or subsystem. A part of, or division of, the whole assembly or equipment.

Component (chemical)
A substance consisting of two or more elements chemically united in definite proportions by weight.

Component part
A term sometimes used to denote a passive device.

Component placement equipment
Automatic systems for sorting and placing components onto hybrid circuit substrates; consisting of indexing-conveyor, sorter, placement heads, missing component detector, programmable electro-pneumatic control, and options to handle special requirements.

Compound bond
In hybrids, the mono metallic bonding of one bond on top of another.

Compression seal
A glass-to-metal seal involving an intentional mismatch of the thermal expansion rates of materials used. The metal outer member has a high rate of expansion, the glass has a medium rate and the center conductor has a low rate. During cooling after the firing process, the outer member shrinks in on the glass, which in turn shrinks in on the pin or lead. The tremendous compressive forces created result in hermeticity without bonding. Since the process depends on physical stress, it offers inherently high mechanical strength when performed properly. This type of seal can be achieved only with all-metal packages. A major advantage of the compression seal is that it allows the use of components that are plated with a corrosion-resistant material, such as nickel, before assembly. This means that the plating will extent past the interface of the glass, thereby preventing corrosion at that critical point. See also "matched seal".

Configuration control
A requirement that a vendor notify the procuring and/or qualifying activity of a change in product manufacture or test. In some cases, the requirement will include delay of change implementation until after formal approval of the change.

Contact step
The drop from the surface of the passivation to the surface of the contact itself.

Contact window
The opening in the surface passivation through which the device metallization makes contact with the circuit elements.

Constant acceleration
The subjection of devices to a G force (typically 30,000 G's) for IC's and (typically 5,000 G's) hybrids, in a centrifuge for a short duration in order to test die-attach, lead bond and package integrity. See MIL-STD-883, Method 2001.

Conveyer
Process equipment designed to receive screen printed substrates and dry the ink on the substrate while conveying them away.

Conductive epoxy
An adhesive material that has electrical conductivity. An epoxy material (polymer resin) that has been made conductive by the addition of a metal powder, usually gold or silver.

Conductivity
The ability of a material to conduct electricity; the reciprocal of resistivity

Conductor adhesive

An adhesive material that has metal powder added to increase electrical conductivity.

Conductor spacing
The distance between adjacent conductor film edges.

Conductor width
The width of individual conductors in a conductive film pattern.

Conductors
A class of materials that conduct electricity easily, i.e., have a low resistivity.

Conformal coating
A thin non-conductive coating, either plastic (e.g., poly-p-xylylene) or inorganic, applied to a circuit for environmental and/or mechanical protection.

Contact angle
The angle made between the bonding material and the bonding pad.

Contact printing
Print mode in screen printing wherein entire substrate contacts bottom surface of screen during print cycle. Necessary when using metal masks.

Contact resistance
In electronic elements, such as capacitors or resistors, the apparent resistance between the terminating electrode and the body of the device.

Contaminant
An impurity or foreign substance present in a material that affects one or more properties of the material.

Continuous belt furnace
A firing furnace that has a continuous belt carrying the unfired substrates through the firing cycle.

Controlling collapse
Controlling the reduction in height of the solder balls in a flip chip processing operation.

Coordinatograph
A drafting machine of great accuracy used in making original artwork for integrated circuits or microcircuits.

Co-Planar leads (flat leads)
Ribbon type leads extending from the sides of the circuit package, all lying in the same plane.

Copper core pin
A round pin formed of sealing alloy around a central core of copper. Normally, the ratio is about 3:1, reducing the electrical resistance of the pin to about one-third of normal.

Corning 7052
The Corning designation for a Borosilicate glass that closely matches the thermal expansion rate of Kovar. This is glass used in making matched seals; also known as "hard glass". See that heading.

Corning 9010
The Corning designation for a potash- soda-lime glass often used in compression seals; it has a medium rate of expansion. Also known as "soft glass". See that heading.

Corona
The flow of small erratic current pulses resulting from discharges in voids in a dielectric during voltage stress; also discharge resulting from ionization of gas surrounding a conductor (frequently luminous) which occurs when the potential gradient exceeds a certain value but is not sufficient to cause sparking.

Corrosion
In semiconductors, a defect in or on the aluminum metallization, usually a white crystalline growth.

Cosmetic defect
A variation from the conventional appearance of an item, such as a slight change in color; not necessarily detrimental to performance.

Coupling capacitor
A capacitor that is used to block DC signals, and to pass high frequency signals between parts of an electronic circuit.

Cover
A top for a microcircuit package which has been formed by a drawing process, thus making it "three-dimensional", as opposed to a lid, which is normally "two-dimensional", or flat. Covers are usually used on plug-in packages, but are sometimes used on flat packages to provide a deeper internal cavity.

Cover layer
Outer layer(s) of insulating material applied over the conductive pattern on the surface of the substrate.

CPU
Central Processing Unit.

Cratering
Defect in which portion of chip under ultrasonic bond is torn loose by excessive amount of energy transmitted through the wire bond leaving a pit.

Crazing
Minute cracks on or near the surface of materials such as a ceramic. Also the propagation of small cracks in the glassivation layer of a semiconductor device.

Creep
The dimensional change with time of a material under load.

Crossover
The transverse crossing of metallization paths without mutual electrical contact and achieved by the deposition of an insulating layer between the conducting paths at the area of crossing.

Crosstalk
Signals from one line leaking into another nearby conductor because of capacitive or inductive coupling or both (i.e., owing to the capacitance of a thick film crossover).

CRS
Cold rolled steel; usually C-1010. It is often specified in all-metal packages when high thermal conductivity and extreme strength are desired.

Crystal growth
The formation of crystals in a material over a period of time and at an established temperature.

Cure time
The total elapsed time between the addition of a catalyst and the complete hardening of a material; also the time for hardening of premixed, frozen, or refrigerated epoxy adhesives.

Curie temperature (curie point)
Above a critical temperature, ferromagnetic materials lose their permanent spontaneous magnetization and ferroelectric materials lose their spontaneous polarization. This critical temperature is the Curie Point. At this point, ferroelectric ceramic capacitors reach a peak in capacitance.

Curing agent
A material which when added to a second material activates a catalyst already present in the second material, thereby bringing about a chemical reaction, usually causing a hardening of the entire mass.

Curis
Extruded material coming out from the edge of bond.

Current carrying capacity
The maximum current which can be continuously carried by a circuit without causing objectionable degradation of the electrical or mechanical properties.

Current carrying edge
That portion of metal over a contact window that is closest to the point at which the metallization stripe enters the contact window.

Current density
The amount of current flow per unit of cross-sectional area within device metallization. For example, a 1 mA current flowing through a metallization stripe that is 3µ wide and 1µ thick would result in a current density of $0.33 \times 10^{+5}$ A/cm2.

Custom circuits
Circuits designed to satisfy a single application requirement (hybrid or monolithic).

Cut and strip
A method of producing artwork using a two-ply laminated plastic sheet, by cutting and stripping off the unwanted portions of the opaque layer from the translucent layer, leaving the desired artwork configuration.

Cut-off
The operation following the final bonding step that separates the bond from the wire magazine.

Cut-off scissors
The scissors on a bonder to sever the wire after bonding.

Cyclic stress

A completed circuit subjected to stress by cycling temperature and load over a period of time to cause premature failure.

D

Darlington amplifier
Type of amplifier employing two transistors in an emitter-to-base hookup which provides high input impedance and high current gain

Data check
Analysis and review of data after devices have been read-and-recorded to ensure that all readings have been properly performed and all rejects have been removed from the lot.

Data log
Same as read-and-record.

Data pack
The operation during which all of the various data generated during the process of screening a lot is verified and organized for shipment to the customer.

Data upset
The loss of stored data in a memory device as a result of burst radiation. The radiation either causes the activation of a parasitic circuit or the reversal of the stored data state.

Date code
A three or four-digit number identifying the inspection lot from which material was selected. The first two digits (or first digit for a three-digit code) identify the year, the last two the week. Normally, the date code is based upon week of seal for the first sublot of the inspection lot.

D-C voltage coefficient
The measure of changes in the primary characteristics of a circuit element as a function of the voltage stress applied.

Defect
Any deviation from the normally accepted characteristics of a product or component.

Definition
The sharpness of a screen printed pattern - the exactness with which a pattern is printed.

Degradation
Change for the worse in the characteristics of an electric element because of heat, high voltage, etc..

Deionized water
Water that has been purified by removal of ionizable materials.

Delta limit
The maximum change in a specified parameter reading which will permit a hybrid microcircuit to be accepted on the specified test, based on a comparison of the final measurement with a specified previous measurement. Note: When expressed as a percentage value, it shall be calculated as a proportion of the previous measured value.

Density
Measured as mass per unit volume or the weight of a material in relationship to its volume or size.

Depletion layer
The region in a semiconductor where essentially all charge carriers have been swept out by the electrical field which exists there.

Destructive testing
Sample testing which is sufficiently severe to make further use of the tested devices questionable. Devices subjected to destructive testing may not actually be destroyed, but are sufficiently degraded that they should not be used in any system.

Detritus
Fragments of material produced during resistor trimming which remain in the trimmed area.

Device
The physical realization of an individual electrical element in a physically independent body which cannot be further reduced or divided without destroying its stated function. This term is commonly applied to active devices. Examples are transistors, pnpn structures, tunnel diodes, resistors, capacitors, and inductors.

Dewetting
The condition in a soldered area in which liquid solder has not adhered intimately and has pulled back from the conductor area.

Diamond powders, grits, and compounds
These materials are used mainly as abrasives for processes such as lapping and polishing, abrasives in abrasive trimming, or to create the cutting surface of slicing equipment.

Dice
The plural of die.

Die
A tiny piece of semiconductor material, broken from a semiconductor slice, on which one or more active electronic components are formed (sometimes called CHIP).

Die bonding
Attaching the semiconductor chip to the substrate, with an epoxy, eutectic, or solder alloy.

Dielectric
1) Non-conducting material through which magnetic lines of force, or electrostatic lines of force may pass. 2) Medium in which it is possible to produce and maintain an electric field with little or no outside energy source.

Dielectric breakdown
The breakdown of the insulation resistance in a medium under high voltage. Also the damage occurring within an oxide layer when a voltage greater than its breakdown strength is applied across it.

Dielectric constant
The term used to describe a material's ability to store charge when used as a capacitor dielectric. It is the ratio of the charge that would be stored with free space as the dielectric to that stored with the material in question as the dielectric.

Dielectric isolation
The use of silicon dioxide barriers created during silicon IC processing to provide isolation between components on a chip.

Dielectric layer
A layer of dielectric material between two conductor plates.

Dielectric loss
The power dissipated by a dielectric as the friction of its molecules opposes the molecular motion produced by an alternating electric field.

Dielectric properties
The electrical properties of a material such as insulation resistance, breakdown voltage, etc..

Dielectric strength
The maximum electric field that a dielectric will withstand without breaking down (physically). Expressed in volts per unit distance, such as centimeter, mil, etc..

Die-on-tape
Dice mounted on flexible ribbon tape by bonding the bonding pads of each die to contacts on a lead frame on the tape, thus allowing electrical and other testing prior to assembly of the die into packages or onto hybrid substrates.

Die shear
The application of sufficient force to shear a die from the die attach medium in order to demonstrate die attach integrity. See MIL-STD-883, Method 2019.

Die sort
Electrically, a probe to sort the dice on a wafer according to predetermined electrical limits. Visually, a sort into Condition A, Condition B, or commercial grade dice.

Diffused area
A portion of the die where impurities have been diffused into the surface of the silicon at high temperature to change its electrical characteristics through the creation of a concentration of N or P charge carriers.

Diffusion
A thermal process by which minute amounts of impurities are deliberately impregnated and distributed into semiconductor material.

Diffusion and oxidation systems
Equipment in which non-conductive materials are made semiconductive by diffusing controlled amounts of selected impurities into the surface and the surface of silicon is oxidized selectively to provide a protective or ingestive layer. Diffusion and oxidation are accomplished by exposing the silicon wafer to specific atmosphere in a high temperature furnace.

Diffusion bond
See Solid Phase Bond.

Diffusion constant
The relative rate at which diffusion takes place with respect to temperature.

Diffusion depth testing
A diffusion depth tester determines to what depth diffused impurities have been implanted.

Digital circuits
A microcircuit in which the inputs accept logic states (such as 0 or 1) and convert these to logic states at the output(s) according to a predetermined set of logic equations or function tables.

Dimpled cover
A cover with a dimpled hole, to allow evacuation and backfill after sealing or pressure relief during sealing. See "dimpled hole".

Dimpled hole
An evacuation hole in a cover which has been displaced inward to form a small truncated cone.

Diode
A semiconductor device with two terminals and a single junction, exhibiting varying conduction properties depending upon the polarity of the applied voltage.

DIP
Abbreviation for Dual in-line package.

Direct contact
A contact made to the semiconductor die when the wire is bonded directly over the part to be electrically connected, as opposed to the expanded contact.

Direct emulsion
Emulsion applied to a screen in a liquid form as contrasted to an emulsion that is transferred from a backing film of plastic.

Direct emulsion screen
A screen whose emulsion is applied by painting directly on the screen - as opposed to indirect emulsion type.

Direct metal mask
A metal mask made by etching a pattern into a sheet of metal.

Discrete
A semiconductor or semiconductor die containing only one active device, such as a transistor or a diode.

Discrete component
A circuit component having an individual identity, such as a transistor, capacitor, or resistor.

Dissipation factor
Tangent of the dielectric loss angle. Dissipation factor is the ratio of the resistive component of a capacitor (Rc) to the capacitive reactance (Xc) of the capacitor.

Distributed processing
In digital data systems, the utilization of a number of dedicated processors distributed throughout the system for the purpose of doing computation locally.

Donor
An impurity that can make a semiconductor N-type by donating extra "free" electrons to the conduction band. The free electrons are carriers of negative charge.

Dopants
Selected impurities introduced into semiconductor substrates in controlled amounts, the atoms of which form negative (n-type) and positive (p-type) conductive regions. Phosphorus, arsenic; and antimony are n-type dopants for silicon; boron, aluminum, gallium, and indium are p-type dopants for silicon.

Doping
Addition of controlled impurities to a non-conductive material to achieve the desired semiconductor characteristic, accomplished through thermal diffusion or ion implantation. Also the introduction of an impurity into the crystal lattice of a semiconductor to modify its electrical properties by creating a concentration of N or P carriers.

DPA (Destructive Physical Analysis)
A device dissection performed for the purpose of analyzing construction or assessing compliance with predetermined specifications.

Drift
Permanent change in value of a device parameter over a period of time because of the effects of temperature, aging, humidity, etc..

Dry air
Air that has been circulated through a drying process to remove water molecules.

Dry inert atmosphere
At inert gas such as nitrogen that has been circulated through a drying process to remove water molecules.

Dryer
A drying tube containing silica gel or a similar moisture absorbent chemical.

Dry-pressing
Pressing and compacting of dry powdered materials with additives together in rigid die molds under heat and pressure to form a solid mass, usually followed by sintering as for alumina substrates.

Dry print
he screened resistor and conductors that have gone through the drying cycle removing the solvents from the ink.

Dual-in-line package (DIP)
Carrier in which a semiconductor integrated circuit is assembled and sealed. Package consists of a plastic or ceramic body with two rows of vertical leads which are inserted into a circuit board and secured by soldering. Also a package (either hermetic or molded) with its leads emanating from both sides of the package, then turning downward. See also Side-brazed dip.

Ductility
That property which permits a material to deform plastically without fracture.

Dumet pin
A round pin made of copper-sheathed 42 alloy. The copper sheath aids the skin effect, giving high RF conductivity. Dumet also has superior corrosion resistance and excellent solderability.

Durometer
An instrument for measuring the hardness of the squeegee material for screen printing.

DUT
Device Under Test.

Dye penetrant
A gross method of checking a package for fairly sizable leaks. A hole is put in the cover of the package and a red dye, involved in some extremely non-viscous fluid such as trichloroethylene, is injected through the hole. The hole is then sealed and a light coating of white developer is sprayed over the outside of the package. If there is a leak, a red stain begins to appear on the outside of the package, in an amount of time depending on the size of the leak. This is a handy method of trouble shooting packages, since it gives a clear visual indication of where the leak occurs.

Dynamic printing force
The fluid force which causes a pseudo plastic paste to flow through a screen mesh and wet the surface beneath. Its absolute value is a complex function of all screen printer operating parameters along with the rheological properties of the fluid being printed.

Dynamic RAM
See RAM

E

EAROM
Electronically Alterable Read Only Memory. Functionally similar to EEPROM.

Ears
A type of plug-in package that has flat areas or flags extending from the main package body, allowing the package to be bolted down. Because of these projections beyond the outline of the package, it is normally sealed as a solder flange-against-flange or resistance weld package. Ears can be similarly used on flat packages.

ECL
Emitter-coupled logic; a type of current mode logic in which the circuits are coupled with one another through emitter followers at the input or output of the logic circuit.

Edge definition
See Definition.

EEPROM (E2PROM)
Electronically Erasable Programmable Read Only Memory - A memory device whose content can be established through a programming process (usually the tunneling of electrons across a thin layer of silicon dioxide to a floating gate). Each memory cell of an EEPROM can be individually erased by imposing a voltage to reverse the flow of electrons to move them away from the floating gate. That cell can then be reprogrammed. Both programming and erasing can be performed without removal of the device from the system in which it is used.

Effectivity date
The date upon which a new military document or a new revision of an existing document goes into effect. See Implementation date.

Ejection
Wipe off or removal of the printed part from the workholder, in screen printing.

Electric field
A region where there is a voltage potential, the potential level changing with distance. The strength of the field is expressed in volts per unit distance.

Electrical element
The concept in uncombined form of the individual building blocks from which electric circuits are synthesized.

Electrical isolation
Two conductors isolated from each other electrically by an insulating layer.

Electrical properties
The properties of a device or material that effect its conductivity or resistivity to the flow of an electric current.

Electrically hot case
A hybrid circuit package that is used as part of the grounding circuit.

Electrodes
The conductor or conductor lands of a hybrid circuit. Also the metallic portions of a capacitor structure.

Electroless plating
Deposit of a metallic material on a surface by chemical deposition as opposed to the use of an electrical current.

Electromigration
Particle migration in aluminum thin-film or polysilicon conductors at grain boundaries as a result of high current densities. Electromigration can lead to either an open circuit condition in a conductor or a short between adjacent connectors.

Electron beam bonding
Process using a stream of electrons to heat and bond two conductors within a vacuum.

Electron beam lithography
Lithography in which the radiation sensitive film or resist is placed in the vacuum chamber of a scanning beam electron microscope and exposed by an electron beam under digital computer control.

Electron beam welding
Process in which welder generates a stream of electrons traveling at up to 60% of the speed of light, focuses it to a small, precisely controlled spot in a vacuum, and converts the kinetic energy into extremely high temperature on impact with the workplace.

Electronic packaging
Enclosing an electronic circuit in an environmentally protective package with input/output leads and with heat removal means.

Electrostatic sensitivity
Susceptibility to damage or degradation as the result of subjection to electrostatic discharge. Typically much higher for MOS devices than for bipolar.

Electrostatic discharge
The discharge of accumulated static charge (typically of high voltage at low current) from one collector to another, usually by jumping the air gap between the two.

Element
A constituent unit which contributes to the operation of a hybrid microcircuit. Integral elements include deposited or screened passive circuit elements, metallization paths, and deposited or formed insulation. Discrete elements include discrete or integrated electronic parts, chips and interconnecting wires or ribbon.

Element (of a microcircuit or integrated circuit)
A constituent of the microcircuit or integrated circuit that contributes directly to its operation. (A discrete part incorporated into a microcircuit becomes an element of the microcircuit.)

Elongation
The ratio of the increase in wire length at rupture, in a tensile test, to the initial length, given in percent.

Embedded
Enclosed in a plastic material.

Emitter
(1) Electrode within a transistor from which carriers are usually minority carriers, and when they are majority carriers, the emitter is referenced to as a majority emitter. (2) For a transistor, a region from which charge carriers that are minority carriers in the base are injected into the base.

Emitter electrode
The metallic pad making ohmic contact to the emitter area of a transistor element.

Emitter junction
Of a transistor, a junction normally biased in the low-resistance direction to inject minority carriers into a base.

Emulsion
The light sensitive material used to coat the mesh of a screen.

Encapsulate
To embed electronic components or other entities in a protective coating, usually done when the plastic encapsulant is in fluid state so that it will set in solid form as an envelope around the work.

Entrapment
The damaging admission and trapping of air, flux, and fumes, caused by contamination and plating process defects.

Entrapped material
Gas or particles bound up in an electrical package that cannot escape.

Environmental test
Per MIL-STD-883, the environmental tests most often used for packages are insulation resistance, moisture resistance, salt atmosphere, temperature cycling, thermal shock, lead fatigue, solderability, and seal.

EOL (end-of-line testing)
Those tests performed in assembly after the seal operation in order to confirm the quality of the device assembly. Testing would normally include such screens as stabilization bake, constant acceleration, temperature cycle, and hermeticity testing.

EOL (end-of-life)
Last time buys for obsoleted semiconductor components.

Epitaxial
Pertaining to a single-crystal layer on a crystalline substrate, and having the same crystalline orientation as the substrate; e.g. silicon atoms condensed from vapor phase onto a silicon-wafer substrate.

Epitaxial growth
A process of growing layers of material on a selected substrate. Usually silicon is grown in a silicon substrate. Silicon and other semiconductor materials may be grown on a substrate with compatible crystalography, such as sapphire (silicon-on-sapphire).

Epitaxial layer
Grown or deposited crystal layer with the same crystal orientation as the parent material, and in the case of semiconductor circuits, is also the same basic material as the original substrate. (Often referred to as "epi".)

Epitaxial transistor
Transistor with one or more epitaxial layers.

Epoxy sealing
Epoxy has occasionally been used to seal hybrid packages, but its use is controversial. Such a package may appear to be hermetic on a fine leak check, but a long-term moisture resistance test will reveal that moisture gets into the package, probably by osmosis, after a period of time. See Osmosis.

EPROM
Erasable Programmable Read Only Memory-A memory device whose content can be established through a programming process (usually hot electron injection) and can be totally erased by exposure to ultraviolet light for sustained periods (typically 30 minutes). When properly erased, the device can be reprogrammed.

Etch factor
The ratio of depth of etch to the amount of undercut.

Etched metal mask
A metal mask used for screening wherein the pattern is created in a sheet of metal by the etching process.

Eutectic
The specific portions of the constituents of an alloy having the lowest melting point. The system goes from totally molten to totally solid without going through a slushy range at the eutectic composition. An alloy of two or more metals with the lowest melting point that is possible from any combination of those metals. The melting point of the eutectic will normally be lower than the melting point of either metal in its pure state.

Eutectic alloy
An alloy having the same temperature for melting and solidus.

Evaporation
One of the final steps in processing a wafer during which conductive metal, usually aluminum, is deposited on the surface of the wafer in order to provide electrical interconnection of the various active elements on each die. Metallization may also be accomplished through sputtering.

Evaporation and sputtering materials

Metals used for evaporation charges and sputtering targets, including chromium and its alloys, for (1) a thin adhesive layer on IC substrates to allow better deposition of gold or other metal, (2) resistor material, and (3) vacuum deposition in mask production; aluminum and certain A1 alloys, for first layer deposition in MOS technology; molybdenum, as a conductor or adhesive layer for IC fabrication; and titanium, as an intermediate adhesive layer for beam lead interconnection.

Evaporation sources

Boats and filaments used as heat sources for vacuum evaporation to form thin film layers on substrates. The process is frequently done by resistively heating the evaporant in a ceramic crucible or by self heating or boats constructed of tungsten, molybdenum, or tantalum.

Expanded contact

A contact made to the semiconductor die where the wire is bonded to an area remote from the part to be electrically connected so that a lateral interconnection path for the current is required.

Exponential failures (wear out)

Failures that occur at an exponentially increasing rate.

Exposure

The act of subjecting photosensitive surfaces or matter to radiant energy such as light to produce an image.

External leads

Electronic package conductors for input and output signals, power and ground. Leads can be either flat ribbons or round wires.

Exothermic

A type of protective gas atmosphere formed by "cracking" natural gas, propane, etc.; often used for glass-to-metal sealing.

Extrinsic properties

Properties introduced into a semiconductor by impurities with a crystal.

Extrinsic semiconductor

The resulting semiconductor produced when impurities are introduced into an otherwise non-semiconductor crystal. The electrical properties depend upon the impurities.

Eyelet

A metal piece with holes through it; usually the basic metal piece that forms a plug-in package. Sometimes called "body".

Eyelet tool

A bonding tool with a square protuberance beneath the bonding tool surface which presses into the conductor and prevents the slippage between wires or conductor and tool interface. Mostly used for ribbon wire bonding.

F

Face-bonding
Method of assembling hybrid microcircuits wherein semiconductor chips are provided with small mounting pads, turned face-down, and bonded directly to the ends of the thin-film conductors on the passive substrate.

Failure analysis
The analysis of a circuit to locate the reason for the failure of the circuit to perform to the specified level. A postmortem examination of failed devices for the purpose of verifying the reported failure and identifying the mode or mechanism of failure. Failure analysis techniques may range from simple electrical and/or visual examination to some of the more advanced techniques of physics, metallurgy, and chemistry. See MIL-STD-883, Method 5003.

Failure mechanism
The physical or chemical process by which a device proceeds to the point of failure.

Failure mode
The cause for rejection of any failed device as defined in terms of the specific electrical or physical requirement which it failed to meet.

Failure rate
The rate at which devices from a given population can be expected (or were found) to fail as a function of time (e.g. percent per 1000 hours of operation or devices per 10^{+6} unit hours).

Fan-out
(1) Number of logical outputs from a circuit. (2) The number of gates that a given gate can drive.

Fatigue
Used to describe a failure of any structure caused by repeated application of stress over a period of time.

Fatigue Factor
The factor causing the failure of a device under repeated stress.

Fault Isolation diagnostics
A feature (normally associated with built-in test) that allows identification of a malfunctioning subcircuit or circuits within a complex device.

Features
See Curls.

Feature size
The smallest controllable dimension on the surface of a die, usually determined by minimum line width.

Feed through
A conductor through the thickness of a substrate, thereby electrically connecting both surfaces.

Ferrite
A powdered, compressed and sintered magnetic material having high resistivity; cores made of sintered powders are used for ferromagnetic applications.

Ferroelectric
A crystalline dielectric that exhibits dielectric hysteresis - an electrostatic analogy to ferromagnetic materials.

Ferromagnetic
A material that has a relative permeability noticeably exceeding unity and generally exhibits hysteresis.

FET
Field effect transistor; semiconductor device in which resistance between source and drain terminals is modulated by a field applied to the third (gate) terminal.

Field-effect transistor
Transistor that uses charge carriers of only one polarity. The input signal modulates a transverse electric field to vary the effective cross-sectional area of the semiconductor, thereby varying the resistance that controls output current. Also called unipolar field-effect transistor; unipolar transistor.

Field trimming
Trimming of a resistor to set an output voltage, current, etc..

Filament short
The growth of a filament between two conductive areas as the result of high thermal or voltage stress, shorting the two areas together.

Filled plastic
Adding ceramic, silica or metal powder to an encapsulant to improve the thermal conductivity.

Filler
A substrate, usually dry and powdery or granular, used to thicken fluids or polymers.

Fillet
A concave junction formed where two surfaces meet.

Film
Single or multiple layers or coatings of thin or thick material used to form various elements (resistors, capacitors, inductors) to interconnections and crossovers (conductors, insulators). Thin film are deposited by vacuum evaporation or sputtering and/or plating. Thick films are deposited by screen printing.

Film conductor
Electrically conductive material formed by deposition on a substrate.

Film integrated circuit
An integrated circuit consisting of elements which are films formed in situ upon an insulating substrate.

Film microcircuit
Thin or thick film network forming an electrical interconnection of numerous devices.

Film network
An electrical network composed of thin film and/or thick film components and interconnections deposited on a substrate.

Film resistor
A device whose resistive material is a film on an insulator substrate; resistance value is determined by trimming.

Final seal
The hybrid microelectronic packaging step which encloses the circuit so that further internal processing cannot be performed without disassembly.

Fine leak
See Hermeticity.

Fire
The term used to describe the act of heating a thick film circuit so that the resistors, conductors, capacitors, etc., will be transformed into their final form.

Firing sensitivity
Refers to the percentage change caused in the fired film characteristics due to a change in peak firing temperature. The firing sensitivity is expressed in units of % per °C.

First bond
The first bond in a sequence of two or more bonds made to form a conductive connection.

First radius
The radius of the front edge of a bonding tool foot.

First search
That period of machine cycle at which final adjustment in the location of the first bonding area (see first bond) under the tool are made prior to lowering the tool to make the first bond.

Fissuring
The cracking of dielectric or conductors. Often dielectrics, if incorrectly processed, will crack in the presence of conductors because of stresses occurring during firing.

Flag
Support area on lead frame for die.

Flame-off
he procedure where the wire is severed by passing a flame across the wire thereby melting it. The procedure is used in gold wire thermocompression bonding to form a ball for making a ball bond.

Flange
A projecting rim or collar on a package, lid or cover, normally to assist in package sealing.

Flat pack
Semiconductor network encapsulated in a thin, rectangular package, with the necessary connecting leads, projecting from the edges of the unit.

Flatness
The deviation from a perfect plane of the seal surface or the substrate mounting area of the package, normally expressed in decimals or fractions of an inch per inch, but sometimes in T.I.R. Flatness is measured by putting the package or substrate in a three-point suspension on the plane from which the deviation is to be measured.

Flattened and pierced pin
A round pin which has a hole through a flat area at the end of the pin; normally on the outside of the package so a large wire can be attached. These pins are most often found on power packages.

Flattened pin
A round pin which has been flattened on one end; the flattened portion is normally on the inside of the package to aid wire bonding.

Flexible coating
A plastic coating that is still flexible after curing.

Flexible strength
Strength of the laminate when it is measured by bending.

Flip chip
Unencapsulated semiconductor device in which bead-type leads terminate on one face to permit flip (face-down) mounting of the device by contact of the leads to the required circuit interconnects.

Flip chip mounting
A method of mounting flip chips on thick or thin film circuits without the need for subsequent wire bonding.

Floating ground
An electrical ground circuit that does not allow connection between the power and signal ground for the same circuit.

Floating squeegee
This squeegee, as opposed to a rigid squeegee, has the ability to produce a rocking movement on the horizontal plane in screen printing.

Flood bar
A bar or other such device on a screen printing device that will drag paste back to the starting point after the squeegee has made a printing stroke. The flood stroke returns the paste without pushing it through the meshes, so it does no printing, only returns the paste supply to be ready for the next print.

Flood stroke
Return stroke of squeegee in screen printing which redistributes ink back over the pattern. Provides for proper ink control, and is especially useful for thixotropic inks (see "print stroke").

Fluid flow masking
A gold electro-plating technique in which the work to be plated is the cathode and current flows through the fluid stream of plating material, allowing control of deposit at the point of contact between the stream and the workplace.

Flux
In soldering, a material that chemically attacks surface oxides and tarnishes so that molten solder can wet the surface to be soldered.

Flux residue
Particles of flux remaining on a circuit after soldering and cleaning operations.

Flying lead
On a flat pack device, a lead which exits from the end rather than the side of the package, then makes a right-angle turn to parallel the other leads.

Foot length
The long dimension of the bonding surface of a wedge-type bonding tool.

Footprint
The area needed on a substrate for a component or element. Usually refers to specific geometric pattern of a chip.

Forcing function
The applied voltage(s) or current(s) at which a parametric or functional test is performed.

Foreign material
Any material that is foreign to a microcircuit or any non-foreign material that is displaced from its original or intended position within a microcircuit package.

Fit seal
Sealing accomplished through the melting and re-hardening of a glass seal ring (or frit) between the package base and lid. The package leads typically pass through the sealing area.

Forming gas
A gas (N2 with trace of H2 and He) used to blanket a part being processed to prevent oxidation of the metal areas.

Frit
Glass variously compounded that is quenched and ground as a basis for glazes or enamels.

Front end
A slang term often applied to the wafer fabrication portion of the semiconductor manufacturing process.

Functional trimming
Trimming of a circuit element (usually resistors) on an operating circuit to set a voltage or current on the output.

Furnace active zone
The thermostatically controlled portion of a multi-zoned muffle furnace.

Furnace, diffusion and firing
Furnace, diffusion and firing. Systems designed for enclosed elevated temperature processing of solid state devices and systems, in gaseous atmospheres. Diffusion furnaces are operated at temperatures from 1000 to 1300°C to achieve doping of semiconductor substrates, by one of a number of processes. Oxidation is a process that puts a protective layer of silicon oxide on the wafer and is used either as an insulator or to mask out certain areas when doping. Deposition systems, of which there are three (liquid, gaseous, solid), are used to deposit impurities on the silicon wafer. Other systems include a drive-in system used to diffuse impurities into the wafer to a specified level, and an alloy system which is used in a final step of the metallization process. Firing furnaces are used for the curing of multilayer ceramics for integrated electronics and for the firing of thick film materials on microcircuits.

Furnace profile
See Firing Profile.

Furnace, screen printing
Process equipment designed to cure substrates after screen printing and drying.

Furnace slave zone
That portion of a multi-zoned muffle furnace where the instantaneous power supplied to the heating element is a set percentage of the power supplied to the active zone. Hence, temperature control in the slave zone is not accomplished by sensing thermocouples as in the case of the active zone.

Fusing
Melting and cooling two or more powder materials together so that they bond together in a homogeneous mass.

G

Gallium Arsenide (GaAs)

A semiconductor base material whose high electron mobility has led it to be used in the fabrication of high speed circuits. GaAs circuits are not considered as easy to manufacture as silicon circuits. Gate array An integrated circuit containing a large number of gates that can be interconnected in any number of combinations to satisfy specific individual applications. See ASIC.

Gas analysis

A method of checking a package for relatively small leaks. After careful cleaning, the completed circuit and the sealed package are placed in the vacuum bomb of a spectrometer, the package is pierced and its contents analyzed. If the package is leaking, the bomb will contain the constituents of air - oxygen, water vapor, neon, argon, etc.. If it is not leaking, the bomb will contain only the atmosphere in which the package was sealed - usually dry nitrogen. This test reveals exactly what has leaked into the package, but it doesn't determine the rate of the leak. A possible disadvantage is that results can be confused by the out-gassing of the microcircuit itself.

Gas blanket

At atmosphere of inert gas, nitrogen, or forming gas flowing over a heated integrated circuit chip or a substrate which keeps the metallization from oxidizing during bonding.

Gate

(1) A circuit having an output and a multiplicity of inputs designed so that the output is energized only when a certain combination of pulses is present at the inputs. An and-gate delivers an output only when every input is energized simultaneously in a specified manner. An or-gate delivers an output pulse when any one or more of the pulses meet the specified conditions. (2) An electrode in a field effect transistor. (3) A circuit that admits and amplifies or passes a signal only when a gating (triggering) pulse is present. (4) A circuit in which one signal serves to switch another signal on and off.

Gate array

An integrated circuit containing a large number of gates that can be interconnected in any number of combinations to satisfy specific individual applications. See ASIC.

Gate equivalent

The basic unit of measure for digital circuit complexity, based upon the number of individual logic gates that would have to be interconnected to perform the same circuit function.

Gate oxide

A thin film of dielectric oxide material bridging the source and drain regions of an MOS semiconductor.

Generic data

Qualification or quality conformance data on devices from the same generic product family as the device shipped.

Generic family
A group of devices manufactured and assembled on the same line(s), using the same processes and materials, and designed to perform the same basic function (e.g., operational amplifiers, TTL gates, etc.).

Germanium polycrystalline
A prime raw material for making crystal ingots.

Glass binder
The glass power added to a resistor or conductor ink to bind the metallic particles together after firing.

Glass flat package
glass package is normally made of two materials, glass as the dielectric and metal as the conductor, with occasional modifications. Hard glass is usually used, since the thermal expansion rate closely matches that of the metal used. The glass used is in the form of preforms, which look somewhat like picture frames. The metal is usually Kovar. A glass flat package is put together rather like a Dagwood sandwich: Start with a bottom and build on it. The package is fired at about 1,000oC. Glass packages are inexpensive, but their mechanical strength is limited and flatness is difficult to achieve.

Glass frit seal
See Flit seal.

Glass phase
The part of the firing cycle wherein the glass binder is in a molten phase.

Glassivation
The protective coating (usually silicon dioxide or silicon nitride) placed on the entire dire surface (exclusive of bonding pads). See Passivation.

Glaze
See "Overglaze".

Glazed substrate
Ceramic substrate with a glass coating to effect a smooth and non-porous surface.

Glossy
A shiny surface usually formed by the glass matrix in a conductor or resistor ink.

Gold/germanium
A solder made of gold and germanium, normally in an 88/12 ratio, for use in higher temperature applications than can be met by the normal gold/tin solder. Eutectic is 359°C.

Gold plating
Usually 50 microinches thick on hybrid circuit packages, but occasionally 100 microinches or other thicknesses. The deposit is usually extremely soft with a matte finish, but a bright finish is sometimes specified. The soft gold has a Knoop value of 70 maximum, and a purity of 99.99%. Hard gold is rarely used.

Gold/tin
A solder normally of 80% gold and 20% tin, used for sealing gold-plated packages. Sometimes the ratio is 78-22 to allow for absorption of the gold plating on the seal surfaces. The 80/20 solder has a eutectic of 280°C.

Grain growth
The increase in the size of the crystal grains in a glass coating or other material over a period of time.

Green
A term used in ceramic technology meaning unfired. For example, a "green" substrate is one that has been formed, but has not been fired.

Green ceramic
Unfired ceramic material.

Green substrate
Unfired material in substrate form. Normally substrates are printed after firing. Under special circumstances, however, green (unfired) substrates are printed.

Gross leak
A leak in a hermetically sealed package greater than 10^{-5} cm^3/s at one atmosphere of differential pressure.

Ground plane
A conductive layer on a substrate or buried within a substrate that connects a number of points to one or more grounding electrodes.

Grounded lead
In a flat package, a lead can be grounded by being welded or brazed to the package wall. When welded, the lead is looped over and the end is welded to the wall. When brazed, a hole is put into or through the package wall and the lead is brazed in place at high temperatures. Brazing is simpler and therefore, more commonly used.

Grounded pin
Pins on plug-in packages can be grounded by welding or brazing. Normally, the pin is brazed in place if it extends on both sides of the plug- in header; it can be butt-welded when it extends on one side only, but is then usually reinforced with a braze.

Grown junction
A PN junction made by controlling the type of impurity in a single crystal while it is being grown from a melt.

H

Halo effect
A glass halo around certain conductors. Generally, this is an undesirable effect to be avoided by changing furnace profiles or material types.

Halogenated hydrocarbon solvents
Organic solvents containing the elements chlorine or fluorine used in cleaning substrates and completed circuits (e.g. trichloroethylene, various freons, etc.).

Hand soldered
Forming a soldered connection with solder using a hand held soldering iron for application of the heat.

Hard glass
The glass used in matched seals; Kimble En-1, Corning 7052, or the equivalent. It has a thermal expansion rate very close to that of Kovar. It is a borosilicate.

Hard solder
Solder that has a melting point above 800°F (425°C).

Hardness
A property of solids, plastics, and viscous liquids that is indicated by their solidity and firmness; resistance of a material to indentation by an indensor of fixed shape and size under a static load or to scratching; ability of a metal to cause rebound of a small standard object dropped from a fixed height; the cohesion of the particles on the surface of a mineral as determined by its capacity to scratch another or be itself scratched.

Hardware
The physical elements and interfaces that constitute a component or system.

HDL
Hardware design language, a software tool used for hardware design. See CAD, VHDL or VHSIC.

Headed pin
A pin that looks like a nail; the large head aids wire bonding by making available a large surface. The headed pin is primarily used when multiple bonds must be made to the pin.

Header
Sometimes called metal can package - A cylindrical semiconductor package with a metal lid and with leads emanating from the package base. A header may or may not have a ceramic standoff to prevent contact with the mounting surface. Base of a hybrid circuit package, holding the leads.

Heat clean
The process of removing all organic material from glass cloth. This is accomplished by heating the glass cloth to approximately 650-700°F for a period of time ranging up to 50 hours.

Heat column
The heating element in a eutectic die bonder or wire bonder used to bring the substrate up to the bonding temperature.

Heat flux
The outward flow of heat from a heat source.

Heat sink
The supporting member to which electronic components or their substrate or their package bottom are attached. This is usually a heat conductive metal with the ability to rapidly transmit heat from the generating source (component).

Heat soak
Heating a circuit over a period of time to allow all parts of the package and circuit to stabilize at the same temperature.

Heel (of the bond)
The part of the lead adjacent to the bond that has been deformed by the edge of the bonding tool used in making the bond. The back edge of the bond.

Heel brake
The rupture of the lead at the heel of the bond.

Heel crack
A crack across the width of the bond in the heel region.

Helium
The gas used in leak detection, because it has the smallest possible, non-flammable molecule (monatomic). See "helium leak check".

Helium leak check
The industry standard for measuring leak rates is expressed in terms of cubic centimeters of helium per second at a pressure differential of one atmosphere.

Hermetic
Theoretically, all packages leak. A "hermetic" package has an acceptable leak rate. For most applications, hermeticity begins at a leak rate of 1 x 10^{-8} cc of helium per second at a pressure differential of one atmosphere, although an even smaller standard is often necessary.

Hermetic device
See Cavity device.

Hermeticity
The ability of a package to prevent exchange of its internal gas with the external atmosphere. The figure of merit is the gaseous leak rate of the package measured in atm-m^3/s. Leak or seal testing performed on all hermetic packages to confirm seal integrity. This is done in two steps, fine leak, which looks at leak rates in the 5 x 10^{-8} cc/sec range, and gross leak, which looks for devices with gross seal defects. See MIL- STD-883, Method 1014.

HIC
Hybrid integrated circuit.

Hi-K
Abbreviation for high dielectric constant.

High K Ceramic
A ceramic dielectric composition (usually BaTiO3) which exhibits large dielectric constants, and non-linear voltage and temperature response.

High-purity alumina
Alumina having over 99% purity of Al2O3.

High temperature reverse bias
Burn-in type test of diodes and transistors conducted with the junctions reverse biased to effect any failure due to ion migration in bonds of dissimilar metals.

High temperature storage
A high temperature (150°C typically) bake performed for an period (usually 24 hours) without electrical power applied. See MIL-STD-883, Method 1008.

Hole
A mobile vacancy or electron deficiency in the valence structure of a semiconductor. The movement of a hole is equivalent to the movement of a positive charge.

Hole diameter
Normally refers to the diameter of the hole through the bonding tool.

Homogeneous
Alike or uniform in composition. A thick film composition that has settled out is not homogeneous, but after proper stirring it is. The opposite of heterogeneous.

Horn
Cone shaped member which transmits ultrasonic energy from transducer to bonding tool.

Hostile environment
An environment that has a degrading effect on an electronic circuit.

Hot spot
A small area on a circuit that is unable to dissipate the generated heat and therefore, operates at an elevated temperature above the surrounding area.

Hot zone
The part of a continuous furnace or kiln that is held at maximum temperature. Other zones are the preheat zone and cooling zone.

HTOT
High Temperature Operating Test - A burn-in performed at very high temperature (typically 250°C) for the purpose of determining long-term reliability of a lot of devices on a sample basis under extremely accelerated conditions. See MIL-STD-883, Method 1005, Condition F.

HTRB
High temperature reverse bias.

Hybrid circuit
A microcircuit consisting of elements which are a combination of the film circuit type and the semiconductor circuit type, or a combination of one or both of these types and may include discrete add-on components.

Hybrid group
(Electrically and structurally similar circuits) Hybrid microcircuits which are designed to perform the same type(s) of basic circuit function(s), for the same supply, bias and single voltages and for input-output compatibility with each other under an established set of loading rules; and which are enclosed in packages of the same construction and outline.

Hybrid integrated circuit
The physical realization of electronic circuits of subsystems from a number of extremely small circuit elements electrically and mechanically interconnected on a substrate.

Hybrid microcircuit
A microcircuit consisting of elements which are a combination of the film circuitry type and the semiconductor types or a combination of one or both of the types with discrete parts. A microcircuit composed of thin or thick film components and semiconductor chips (either integrated circuits or discretes) on a substrate.

Hybrid microelectronics
The entire body of electronic art which is connected with or applied to the realization of electronic systems using Hybrid Circuit technology.

Hybrid microwave circuit
See Microwave Integrated Circuit

I

IC
Abbreviation for integrated circuit.

IC socket
Female contact which provides pliable electrical engagement on its inner surface for integrated circuit components to achieve interfacing to a PCB.

IEPS
International Electronics Packaging Society (now IMAPS).

Image/pattern
The printed area or design on the substrate after screen printing.

IMAPS
In 1996, ISHM IEPS (International - electronic and Packaging Society) formed International Microelectronics and Packaging Society.

Imbedded layer
A conductor layer having been deposited between insulated layers.

Implementation date
The date by which a new military document or a new revision of an existing document must be implemented by those to whom its requirements apply. This date may be different than and later than the effectivity date.

Inactive flux
Flux that becomes non-conductive after being subjected to the soldering temperature.

Inclined plane furnace
A resistor firing furnace having the hearth inclined so that a draft of oxidizing atmosphere will flow through the heated zones through natural convection means.

Incomplete bond
A bond impression having dimensions less than normal size due to a portion of the bond impression being missing.

Indirect emulsion
Screen emulsion that is transferred to the screen surface from a plastic carrier or backing material.

Indirect emulsion screen
A screen whose emulsion is a separate sheet or film of material, attached by pressing into the mesh of the screen (as opposed to the direct emulsion type).

Inert atmosphere
A gas atmosphere such as helium or nitrogen that is non-oxidizing or non-reducing of metals.

Infant mortality (early failures)
The time regime during which hundreds of circuits are failing at a decreasing rate (usually during the first few hundred hours of operation).

Infrared
The band of electromagnetic wavelengths lying between the extreme of the visible and the shortest microwaves. Warm bodies emit the radiation and bodies which absorb the radiation are warmed.

Ingot growth
The process through which an ingot of semiconductor material is created.

Injection molded
Molding of electronic packages by injecting liquefied plastic into a mold.

Ink
In hybrid technology, the conductive or resistive paste used on thick film materials to form the printed conductor pattern. Usually contains metals, metal oxide, glass frit, and solvent.

Ink blending
See Blending.

In-process
Some step in the manufacturing operation prior to final testing.

Input/output
Interface circuits or devices offering access between external circuits and the central processing unit or memory.

Insertion loss
The difference between the power received at the load before and after the insertion of apparatus at some point in the line.

Inspection
Actual performance of a screening step, as opposed to surveillance.

Inspection lot
A lot of devices which is considered a single lot for qualification or quality conformance inspection purposes. An inspection lot may consist of more than one device type if they are from the same generic family. The most generally accepted definition of an inspection lot is a group of devices in a single package type, outline, and lead finish manufactured on the same production line(s) through final seal by the same production techniques, using the same materials, and sealed within the same 6-week period or as specified in a typical military specification.

Inspection sublot
A quantity of hybrid microcircuits, which is part of or an entire inspection lot, submitted for inspection at one time to determine compliance with the requirements and acceptance criteria of the applicable procurement document. Each inspection sublot of circuits should be a group identified as having common manufacturing experience through all significant manufacturing operations.

Insulating layer
A dielectric layer used to isolate multilevel conductive and resistive material or to protect top level conductive resistive material. See Glassivation, Passivation.

Insulation resistance (IR)
The resistance to current flow when a potential is applied. IR is measured in megohms.

Insulator
(1) Material of such low conductivity that the flow of current through it can usually be neglected. (2) Device having high-electric resistance, used for supporting or separating conductors so as to prevent undesired flow of current from the conductors to other objects.

Insulators
A class of materials with high resistivity. Materials that do not conduct electricity. Materials with resistivity values of over 10 ohm-cm are generally classified as insulators.

Integrated circuit
A microcircuit consisting of interconnected elements inseparably associated and formed in situ on or within a single substrate to perform an electronic circuit function. A semiconductor or semiconductor die containing multiple elements (which may be located on the die or on a hybrid substrate) which act together to form the completed device circuit. See IC.

Integrated circuits (IC)
Electronic circuits or systems consisting of an interconnected array of extremely small active and passive elements, inseparably associated on or within a continuous substrate or body. Other names are integrated electronic circuit, integrated electronic system, and integrated microcircuit.

Integrated injection logic
Integrated circuit logic which uses bipolar transistor gates. Makes possible large scale integration on silicon for logic arrays and other analog and digital applications.

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

Interface
The boundary between dissimilar materials, such as between a film and substrate or between two films.

Interfacial bond
An electrical connection between the conductors on the two faces of a substrate.

Inter metallic bond
The ohmic contact made when two metal conductors are welded or fused together.

Intermetallic compound
A compound of two or more metals that has a characteristic crystal structure that may have a definite composition corresponding to a solid solution - often refractory.

Internal visual
Visual inspection of the device prior to seal to insure that die, wires and package conform to all applicable specifications. See MIL-STD-883, Method 2010 and Method 2017. See Pre-Seal Visual.

Internal water vapor content
The amount of residual moisture trapped within a semiconductor package cavity after device sealing, usually stated in ppm at 100°C.

Intraconnections
Those connections of conductors made within a circuit on the same substrate.

I/O
Input/output.

Ion implantation
Precise and reproducible method of doping semiconductors to achieve a desired characteristic. Ions of the particular dopant are energized and accelerated to the point where they can be driven in a focused beam directly into the silicon wafer. This technique assures uniform, accurately controlled depth of implantation and ionic diffusion in the wafer. Introduction into a semiconductor of selected impurities in controlled regions (via high voltage ion bombardment) to achieve desired electronic properties.

Ion milling
Ion milling is a VLSI production technique that performs many of the same type of tasks that more traditional wet chemical and plasma etching processes do.

Ionizable material
Material that has electrons easily detracted from atoms or molecules thus originating ions and free electrons that will reduce the electrical resistance of the material.

Ion-migration
The movement of free ions within a material or across the boundary between two materials under the influence of an applied electric field.

ISHM
The International Society for Hybrid Microelectronics. Now called IMAPS since 1996.

Isolation diffusion
In MIC technology, the diffusion step which generates back-to-back junctions to isolate active devices from one another.

Isolation tub
An area of the die surrounded by an isolation diffusion (normally P+) to prevent electrical leakage between adjacent circuit elements.

J

JAN
Joint Army Navy -- The trademarked designator used to indicate that a given device was manufactured and screened in accordance with a controlled government specification. The JAN mark is frequently abbreviated to J when used on smaller devices.

Jump bond
See Skip bond.

Jumper
A direct electrical connection between two points on a film circuit. Jumpers are usually portions of bare or insulated wire mounted on the component side of the substrate.

Junction
A joining of two different semiconductors or of semiconductor and metal. Alloy, diffused, electrochemical, and grown are the four junction types. The boundary between a P-region and an N-region in a silicon substrate.

Junction burnout
See Thermal secondary breakdown.

Junction temperature
The temperature of the region of transition between the P-type and N-type semiconductor material in a transistor or diode element.

K

K
Symbol for dielectric constant.

K factor
This term refers to thermal conductivity, the ability of a substance to conduct heat through its mass.

Kerf
That portion of the resistor area of a microcircuit from which resistor material has been removed or modified by trimming.

Kiln
A high temperature furnace used in firing ceramics.

Kirkendall Voids
The formation of voids by diffusion across the interface between two different materials, in the material having the greater diffusion rate into the other. See Bimetallic contamination.

Kovar
Originally the Westinghouse trade name for an alloy of nickel, iron and cobalt, now owned by Carpenter Steel. Other companies have other names for similar alloys, among then Rodar, Therlo, and F- 15, MIL-STD-1276B has specifications for these and other metals used in hybrid packaging.

L

Lamda (l)
Similar to an LTPD, except that it is expressed in percent per thousand hours.

Land area
That portion of the package lead which is inside the package cavity and to which the bonding wire will be connected to make electrical contact with the die.

"L" cut
A trim notch in a film resistor that is created by the cut starting perpendicular to the resistor length and turning 90 degrees to complete the trim parallel to the resistor axis thereby creating an "L" shaped cut.

Ladder network
A series of film resistors with values from the highest to the lowest resistor reduced in known ratios.

Laminar flow
A directed stream of filtered air moved constantly across a clean work station, usually parallel to the workbench surface.

Laminate
A layered sandwich of sheets of substances bonded together under heat and pressure to form a single structure.

Land area in image
Closed spaces in the screen which result in open spaces on the printed image in screen printing.

Lands
Widened conductor areas on the major substrate used as attachment points for wire bonds or the bonding of chip devices.

Lapping
The process of using a rotating disk with an abrasive to grind or polish metal, glass and gems. Even though coined flat-packaged frames are very flat - to within .003" - most manufacturers lap them 100%, so they are flat within a couple of ten thousandths of an inch.

Large-scale integration
Usually denotes arrays of integrated circuits on a single substrate that comprise 100 or more individual active circuit functions or gates.

Laser bonding
A process which forms a metal-to- metal fastened union, using a laser heat source to join conductors.

Laser trim
The adjustment (upward) of a film resistor value by applying heat from a focused laser source to remove material.

Laser welding
Process in which thermal energy released by a laser impinging upon the surface of a metal is conducted into the bulk of the metal work-piece by thermal conduction, bonding component leads to highly conductive materials such as copper printed circuitry.

Latchup
A condition where the output of a circuit has become fixed near one of the two voltage extremes and will no longer react to changes in the input signal. Latchup may be radiation induced, but can also result from voltage overstresses and other causes.

Lattice structure
A stable arrangement of atoms and their electron-pair bonds in a crystal.

Layer
One of several films in a multiple film structure on a substrate.

Layout
The positioning of the conductors and/or resistors on artwork prior to photo-reduction of the layout to obtain a working negative or positive used in screen preparation.

Leaching
In soldering, the dissolving (alloying) of the material to be soldered into the molten solder.

LCC
See Chip carrier.

Lead
A conductive path which is usually self-supporting.

Lead bend
(1) A torsion test for lead strength. See Lead fatigue. (2) The process whereby flatpack leads are reformed to facilitate mounting on a PC board.

Lead fatigue
Application of a repetitive bending force to the leads of sample devices to insure structural integrity of leads and packages. See MIL-STD-883, Method 2004.

Lead frame
The metal part of a solid state device package which achieves electrical connection between the die and other parts of the system of which the IC is a component. Large scale integrated circuits are welded onto lead frames in such a way that leads are available to facilitate making connections to and from the various solid state devices to the packages.

Lead Integrity
See Lead fatigue.

Lead wires
Wire conductors used for intra-connections or input/output leads.

Leadless device
A chip device having no input/output leads.

Leadless inverted device (LID)
A shaped, metallized ceramic form used as an intermediate carrier for the semiconductor chip devices, especially adapted for attachment to conductor lands of a thick or thin film network by reflow solder bonding.

Leadless package
See Chip carrier also LCC.

Leak detectors
Applied only to hermetic devices, fine leak detectors are used to detect defects in sealing that are too small to be detected by gross-leak methods. Devices are placed in a bomb pressurized with a mixture of gases.

Leakage current
An undesirable small stray current which flows through or across an insulator between two or more electrodes, or across a back biased junction.

Leak test
See Hermeticity.

Leveling
A term describing the settling or smoothing out of the screen mesh marks in thick films that takes place after a pattern is screen printed.

LID
Leadless inverted device.

Lid torque
A test which tests the integrity of the seal of a semiconductor device (usually one that employs a glass frit seal) by twisting the package and the lid in opposite but parallel directions.

Life aging
Burn-in test which moderates the elevation of temperature and extends the time period in order to test overall device quality as opposed to infant mortality.

Life-drift
The change in either absolute level or slope of a circuit element under load. Rated as a percentage change from the original value per 1000 hours of life.

Life test
Test of a component or circuit under load over the rated life of the device.

Lift-off mark
Impression in bond area left after lift- off removal of a bond.

Line Certification
Certification that a production line process sequence is under control and will produce reliable circuits in compliance with requirements of applicable mandatory documents.

Line definition
A descriptive term indicating a capability of producing sharp, clean screen printed lines. The precision of line width is determined by twice the line edge definition/line width. A typical precision of 4% exists when the line edge definition/ line width is 2%.

Linear circuits
A circuit with an output that changes in magnitude with relation to the input as defined by a constant factor (see analog circuit).

Lines
Conductor runs of a film network.

Line width
A measure of the horizontal dimensions of surface features of a semiconductor die, such as the separation between gate and drain diffusions on an MOS die. Visually measured in microns.

Liquidus
The line on a phase diagram above which the system has molten components. The temperature at which melting starts.

Load life
The extended period of time over which a device can withstand its full power rating.

Loop
The curve or arc by the wire between the attachment points at each end of a wire bond.

Loop height
A measure of the deviation of the wire loop from the straight line between the attachment points of a wire bond. Usually it is the maximum perpendicular distance from this line to the wire loop.

Logic
A mathematical arrangement using symbol to represent relationships and quantities, handled in a microelectronic network of switching circuits, or gates, which perform certain functions; also, the type of gate structure used in part of a data processing system.

Loss tangents
The decimal ratio of the irrecoverable to the recoverable part of the electrical energy introduced into an insulating material by the establishment of an electric field in the material.

Low-loss substrate
A substrate with high radio-frequency resistance and hence slight absorption of energy when used in a Microwave Integrated Circuit.

LSI

Large Scale Integration -- LSI devices are generally accepted to be those that contain between 100 and 1000 gate equivalents, or other circuitry of similar complexity. See VLSI.

LTPD

Lot Tolerance Percent Defective -- A single lot sampling concept that statistically ensures rejection of 90% of all lots having a greater percent defective than the specified LTPD.

M

Macrocell
A semiconductor building block containing a relatively complex electronic function that can be combined through CAD with other cells to perform a complex function with less design effort than a complete "ground-up" design.

Magnetic integrated circuit
The physical realization of one or more magnetic elements inseparably associated to perform all, or at least a major portion of its intended function.

Majority carrier
The mobile charge carrier (hole or electron) that predominates in a semiconductor material. When a channel is created within the silicon, the channel will normally result from a change of majority carrier.

Mask
The photographic negative that serves as the master for making thick film screens and thin film patterns. A patterned screen of any of several materials used to expose selected areas of a semiconductor covered with a light-sensitive photoresist to polymerizing light during the fabrication process.

Masks, microelectronic
Thin metals or other materials with an open pattern designed to mask off or shield selected portions of semiconductors or other surfaces during deposition processes. There also are photomasks or optical masks for contact or projection printing of wafers - these may use an extremely flat glass substrate with iron oxide, chrome, or emulsion coating. There also are thick film screen masks.

Mass spectrometer
An instrument used to determine the leak rate of a hermetically sealed package by ionizing the gas outflow permitting an analysis of the flow rate in cm^3/S at one atmosphere differential pressure.

Master batch principle
Blending resistor pastes to a nominal value of ohms/sq. The nominal value is the master control number.

Master layout
The original layout of a circuit.

Matched seal
A glass-to-metal seal in which all of the components have approximately the same rate of thermal expansion and therefore, expand and contract at approximately the same rate of speed. Hermeticity is achieved by a molecular bonding of the molten glass to an oxide on the surface of the metal. This type of seal normally uses Kovar metal or equivalent and "hard glass".

Matte finish
A surface finish on a material that has a grain structure and diffuses reflected light.

MCM
See Multi-Chip-Module.

Mechanical shock
An impact-type shock test to stress die attach, wire bonds, and seal integrity, normally performed on a sample basis. See MIL-STD-883, Method 2002.

Medium scale integration (MSI)
The physical realization of a microelectronic circuit fabricated from a single semiconductor integrated circuit having circuitry equivalent to more than 10 individual gates or active circuit functions.

Megarad
Capable of withstanding total dose radiation of 10^{+6} rads (Si) or greater without significant performance degradation.

Memory
The storage capability or location in a computer system which receives and holds information for later use. also, the storage arrangement, such as RAM or other type.

Meniscus
The localized convex area of the package through which the lead protrudes.

Mesa transistor
Transistor in which a germanium or silicon wafer is etched down in steps so the base and emitter regions appear as physical plateaus above the collector region.

Mesh size
The number of openings per inch in a screen. A 200-mesh screen has 200 openings per linear inch, 40,000 openings per square inch.

Metal can package
See Header.

Metal inclusion
Metal particles imbedded in a non-metal material such as a ceramic substrate.

Metal gate
An MOS process fabricated with a metal (usually aluminum) as the gate electrode.

Metal mask (screens)
A screen made not from wire or nylon thread but from a solid sheet of metal in which holes have been etched in the desired circuit pattern. Useful for precision and/or fine printing and for solder cream printing.

Metal-oxide-semiconductor (MOS)
A metal over silicon oxide over silicon arrangement which produces circuit components such as transistors. Electrical characteristics are similar to vacuum tubes.

Metal-to-glass seal (or glass to metal seal)
An insulating seal made between a package lead and the metal package by forming a glass bond to oxide layers on both metal parts. In this seal, the glass has a coefficient of expansion that closely matches the metal parts.

Metallization
A film pattern (single or multilayer) of conductive material deposited on a substrate to interconnect electronic components, or the metal film on the bonding area of a substrate which becomes a part of the bond and performs both an electrical and a mechanical function.

Metallization melt
The melting of semiconductor metallizaton as a result of extreme power exposure, normally occurring as a result of short duration, high current pulses.

Metallization run
A lot of wafers metallized at the same time. Since the number of wafers accommodated by an evaporation (i.e., metallization) chamber is frequently less than the number of wafers accommodated by a diffusion chamber, it is possible to have several metallization runs which came from the same wafer run.

Metric units
Units defined by the International System of Units based on "Le system International d'Unites (SI)" of the International Bureau of Weights and Measures. These units are described in ASTM E380-79 or successor documents as listed in the DOD Index of Specifications and Standards.

Metrication
Act of developing metric standardization documents or converting current standardization documents to metric units of measurement.

MIC
Monolithic integrated circuit.

MIC Technology
An Aeroflex company that manufactures thin film circuit substrates.

Microbond
A bond of small wire such as .001" diameter. gold to a conductor or to a chip device.

Microcircuit
A small circuit having a high equivalent circuit element density, which is considered as a single part composed of interconnected elements on or within a single substrate to perform an electronic circuit function. (This excludes printed wiring boards, circuit card assemblies and modules composed exclusively of discrete electronic parts.)

Microcircuit module
An assembly of microcircuits or an assembly of microcircuits and discrete parts, designed to perform one or more electronic circuit functions, and constructed such that for the purposes of specification testing, commerce, and maintenance, it is considered indivisible.

Micro-components
Small discrete components such as chip transistors and capacitors.

Microcracks
A thin crack in a substrate or chip device, or in thick film trim-kerf walls, that can only be seen under magnification and which can contribute to latent failure phenomena. A very small crack within the metal or other material of a semiconductor device, typically not detectable using optical magnification. In the metallization area, microcracks most typically occur at contact steps. Microcracks can lead to discontinuities in the circuitry.

Microelectronics
That area of electronic technology associated with or applied to the realization of electronic systems from extremely small electronic parts or elements.

Microelectronic devices
See Microcircuit.

Microminiaturization
The process of packaging an assembly of microminiature active and passive electronic elements, replacing an assembly of much larger and different parts.

Micromodule
A microcircuit constructed of a number of components (e.g., microwafers) and encapsulated to form a block that is still only a fraction of an inch in any dimension.

Micron (µ)
A unit of length equal to a micrometer (µm) i.e. 1/1,000,000 of a meter or 1 mil = 25.4 microns. A unit of length. 10^{+6}µ = 1m (meter). [Note: As a symbol of length should not be confused with µ used as a prefix to indicate microunits, such as µA (microamps) or µV (microvolts). A micron is one micrometer.]

Micropositioner
An instrument used in positioning a film substrate or device for bonding or trimming.

Microprobe
An extremely sharp and small exploring tool head attached to a positioning handle, used for testing microelectronic circuits by establishing ohmic contact.

Microprocessor
An IC package incorporating logic, memory, control, computer, and/or interface circuits, the whole of which is designed to handle certain functions.

Microstrip
A microwave transmission component usually on a ceramic substrate.

Microstructure
A structure composed of finely divided particles bound together.

Microwave integrated circuit
A miniature microwave circuit usually using hybrid circuit technology to form the conductors and attach the chip devices.

Migration
An undesirable phenomenon whereby metalizations, notably silver, are transmitted through another metal, or across an insulated surface, in the presence of moisture and an electrical potential. The relocation or movement of physical materials into or across other adjacent materials. See Electromigration.

Mil
A unit equal to .001 inch or .0254 mm.

Minority carrier
The less-predominant carrier in a semiconductor. Electrons are the minority in p-type; holes are the minority in n-type semiconductors.

Mislocated bond
See off bond.

Mobility
The ease with which charge carriers can move through a semiconductor. Generally electrons and holes do not have equal mobility a given semiconductor. Mobility is higher in germanium than in silicon.

Module
A packaging unit displaying regularity and separable repetition. It may or may not be separable from other modules after initial assembly. Usually all major dimensions are in accordance with a prescribed set of dimensions.

Moisture resistance
Subjection of sample devices to a cycle of high humidity and temperature stresses to determine the ability of these devices to survive under severe environmental conditions. This is normally performed on a sample basis with 10 cycles of 24-hour duration. See MIL-STD-883, Method 1004.

Moisture stability
The stability of a circuit under high humidity conditions such that it will not malfunction.

Molded device
A device which is completely encapsulated in epoxy or an alternate molding compound, that is, with no internal cavity.

Molecular beam epitaxy equipment
This equipment is used for growing epitaxial thin films under UHV conditions by directing beams of atoms or molecules created by thermal or electron beam evaporation onto clean, heated substrates.

Molecular electronics
Simply, electronics on a molecular scale, dealing with the production of complex circuitry in semiconductor devices with integral elements processed by growing multi-zoned crystals in a furnace for the ultimate performance of electrical functions.

Monocrystalline structure
The granular structure of crystals which have uniform shapes and arrangements.

Monolithic ceramic capacitor
A term sometimes used to indicate a multilayer ceramic capacitor.

Monolithic device
A device whose circuitry is completed contained on a single die or chip.

Monolithic integrated circuit
An integrated circuit consisting of elements formed in situ on or within a semiconductor substrate with at least one of the elements formed within the substrate.

Morphology, integrated
The structural characterization of an electronic component in which the identity of the current or signal modifying areas, patterns, or volumes has become lost in the integration of electronic materials, in contrast to an assembly of devices performing the same function.

Morphology, translational
The structural characterization of an electronic component in which the areas or patterns of resistive, conductive, dielectric, and active materials in or on the surface of the structure can be identified in a one-to-one correspondence with devices assembled to perform an equivalent function.

MOS
Metal-oxide-semiconductor. A technology for producing transistors that incorporates metal over oxide over silicon layers. Electrical characteristics are similar to vacuum tubes.

MOS device
Abbreviation for a metal oxide semiconductor device.

Mother board
A circuit board used to interconnect smaller circuit boards called "daughter boards".

MSI
Medium Scale Integration -- MSI devices are generally accepted to be those that contain 12 or more gate equivalents, but less than 100. (See LSI.)

MTBF
Abbreviation for Mean-Time-Between-Failures. A term used to express the reliability level. The reciprocal of the failure rate. The average number of operating hours after a device has failed that would pass before the next device failure would be expected to occur.

MTNS
Metal thick nitride semiconductor, which is similar to an MTOS device except that a thick silicon nitride or silicon nitride-oxide layer is used instead of just plain oxide.

MTOS
Metal thick oxide semiconductor, where the oxide outside semiconductor, where the oxide outside the desired active gate area is made much thicker in order to reduce problems with unwanted parasitic effects.

Mu metal
Trade name for an alloy of iron, nickel, copper and molybdenum, which has high magnetic permeability. Sometimes specified for all-metal packages when magnetic shielding is desired.

Multichip device
A device containing two or more die, but no thin or thick film components on the substrate (such as the LH2111, which consists of two LM111 chips in a single package).

Multichip integrated circuit
An integrated circuit whose elements are formed on or within two or more semiconductor chips which are separately attached to a substrate or header.

Multichip microcircuit
A microcircuit consisting of elements formed on or within two or more semiconductor chips which are separately attached to a substrate.

Multi Chip Module (MCM)
A hybrid circuit with a high density interconnect pattern, high silicon to substrate area ratios, and complex IC such as microprocessor, memories, or ASICS. "A politically correct hybrid" according to Walter Becker of SemiDice.

Multilayer ceramic capacitor
A miniature ceramic capacitor manufactured by paralleling several thin layers of ceramic. The assembly is fired after the individual layers have been electroded and assembled.

Multilayer circuits
A composite circuit consisting of alternate layers of conductive circuitry and insulating materials (ceramic or dielectric compositions) bonded together with the conductive layers interconnected as required.

Multilayer dielectric
A compound including glass and ceramic which isolates two layers of conductors.

Multilayer substrates
Substrates that have buried conductors so that complex circuitry can be handled. Assembled using processes similar to those used in multilayer ceramic capacitors.

Multilayer metallization

Metallization formed through the deposition of several layers of different metals to form a single metallization stripe on the surface of the device.

Multilevel metallization

Metallization formed through the deposition of several layers of metal with dielectric (such as SiO2) separating the various levels except where interconnection of levels is required.

Multiple circuit layout

Layout of an array of identical circuits on a substrate.

N

N-channel
An MOS process in which MOS transistors are formed by bridging two adjacent N-type diffusions (source and drain) with a dielectric (gate). When the source and the substrate are grounded and a positive voltage is applied to the gate, a conductive sheet of negative charge (N-channel) is created in the surface of the substrate under the dielectric.

Nail head bond
An alternate term for Ball bonding. See ball bond.

NAND-circuit
Circuit which inverts the normal output of an AND circuit; a NOT-AND circuit.

Neck break
A bond breaking immediately above gold ball of a thermo-compression bond.

Negative image
The reverse print of a circuit.

Negative temperature coefficient
he device changes its value in the negative direction with increased temperature.

Network
A collection of elements, such as resistors, coils, capacitors, and sources of energy, connected together to form several interrelated circuits.

Neutron radiation
Exposure of a device to neutron radiation during fabrication in order to reduce minority carrier lifetime in the substrate. This minimizes the probability of circuit latchup during exposure to burst radiation.

Nickel plating
Nickel plating on hybrid circuit packages is usually one of two types. Electroless nickel is usually deposited in accordance with military specification MIL-C-26074B. The second type is electro-deposited nickel per QQN-290A. Electroless nickel has a much lower melting point than electro-deposited nickel. Electroless nickel is usually used as a final finish, while electro-deposited nickel is usually used for pre-glass sealing plating for compression seals.

NMOS
N-channel MOS circuits, using currents made up of negative charges and production devices at least twice as fast as PMOS.

Noble metal paste
A soft, moist, smooth compound made up partially of precious metals such as gold, platinum, ruthenium, or others classed as noble metals, providing conductors in film circuitry.

Noble system
Thick film system using conductors of gold, platinum, and possible palladium silver, or certain alloys of these precious metals.

Noise
Random small variations in voltage or current in a circuit due to the quantum nature of electronic current flow, thermal considerations, etc.

Noise characteristic
The characteristics of a resistor to emit unwanted signals within a dynamic electrical system.

Nominal resistance value
The specified resistance value of the resistor at its rated load.

Non-conductive epoxy
An epoxy material (polymer resin) either without a filler or with a ceramic powder filler added for increasing thermal conductivity and improving thixotropic properties. Non-conductive epoxy adhesives are used in chip to substrate bonds where electrical conductivity to the bottom of the chip is unnecessary or in substrate-to-package bonding.

Non-destructive bond pull
Pull stressing of all wires on all devices or a sample of devices from a given lot to a pull force which is lower than the minimum pull force limit imposed for destructive bond pull. See MIL-STD-883, Method 2023.

Non-linear dielectric
A capacitor material that has a non-linear capacitance voltage relationship. Titanate (usually barium titanate) ceramic capacitors (Class II) are non-linear dielectrics. NPO and Class I capacitors are linear by definition

Non-standard part
A device procured to a contractor prepared specification rather than to a government prepared specification.

Non-noble system
Thick film system using conductors of cooper, tungsten, nickel, molybdenum, and other non-noble metals.

NPN transistor
A junction transistor constructed by placing a P-type base between an N-type emitter and an N-type collector. The emitter is normally negative with respect to the base and the collector is normally positive with respect to the base.

NPO
A commonly used code that is synonymous with EIA code COG. Both indicate a temperature characteristic of ±30 ppm per °C or less for a capacitor.

N-Region
The zone in a semiconductor in which electron density is greater than hole density.

N-type
Semiconductor material whose impurities produce free electrons in the compound, leading to conduction.

N-type semiconductor
An extrinsic semiconductor in which the conduction-electron density exceeds the hole density. By implication, the net ionized impurity concentration is a donor type.

Nugget
The region of recrystallized material at a bond interface which usually accompanies the melting of the materials at the interface.

Number 42 alloy
An alternate glass sealing alloy, of nickel and iron. Its rate of expansion is different from that of Kovar.

Number 52 alloy
This is an alloy composed of 52% nickel, 48% iron. It is used in making compression seals.

O

Occluded contaminant
Contaminants that have been absorbed by a material.

Off bond
Bond which has some portion of the bond area extending of the bonding pad.

Off-contact printing
Print mode wherein screen printer's squeegee stretches screen to touch the substrate and deposit ink. Usually 0.010" snap-off is used. Allows thicker ink deposition.

Off contact screener
A screener machine that uses off contact printing of patterns on to substrates.

Ohmic contact
A contact that has linear voltage current characteristics through out its entire operating range.

Ohms/square
The unit of sheet resistance, or more properly, of sheet resistivity.

Operating life
Burn-in (that is, exposure to high temperature with electrical bias applied) performed for extended duration (usually one thousand hours at 125°C). Normally a sample test. See MIL-STD-883, Method 1005.

Operator certification
A program wherein an operator has been qualified and certified to operate a machine.

Organic flux
A flux compound of rosin base and a solvent.

Organic vehicle
The organic vehicle in a flux is the rosin base material.

Osmosis
Diffusion through a semi-permeable membrane. An important consideration in epoxy sealing because, although an epoxy seal package can be shown as hermetic on a helium leak check, a long-term moisture resistance test reveals that moisture gets into the package, probably by osmosis, after a period of time. Gas analysis will detect this, but the other two methods of fine leak inspection will not detect it effectively, because they normally take place too soon after sealing to measure long-term changes.

Outgas
The release of gas from a material over a period of time.

Overbonding
See chopped bond.

Overcoat
A thin film of insulating material, either plastic or inorganic (e.g., glass or silicon nitride) applied over integral circuit elements for the purposes of mechanical protection and prevention of contamination.

Overglaze
A glass compound in low-melting, vitreous form, used as a coating to passivate thick film resistors and offer mechanical protection.

Overlap
The contact area between a film resistor and film conductor.

Overlay
One material applied over another material.

Overspray
The unwanted spreading of the abrasive material coming from the trim nozzle in a resistor trimming machine. The overspray affects the values of adjacent resistors not intended to be trimmed.

Overtravel
Overtravel is the excess downward distance a squeegee blade would push the screen if the substrate were not in position.

Oxide Isolation
The separation of circuit elements on a semiconductor device through the construction of a barrier oxide between the elements (not to be confused with dielectric isolation, in which the isolation passes completely under the circuit element.)

Oxidizing atmosphere
An air, or other oxygen containing atmosphere in a firing furnace which oxidizes the resistor materials while they are in the molten state thereby increasing their resistance.

P

P-channel
An MOS process in which MOS transistors are formed by bridging two adjacent P-type diffusions (source and drain) with a dielectric (gate). When the source and the substrate are grounded and a negative voltage is applied to the gate, a conductive sheet of positive charge (P-channel) is created in the surface of the substrate under the dielectric.

Package
The container for an electronic component(s) with terminals to provide electrical access to the inside of the container. In addition, the container usually provides hermetic and environmental protection for, and a particular form factor to, the assembly of electronic components.

Package cap
The cup-like cover that enclosed the package in the final sealing operation.

Package lid
A flat cover plate that is used to seal a package cavity.

Packaging
The process of physically locating, connecting, and protecting devices or components.

Packaging density
The number of devices or equivalent devices per unit volume in a working system or subsystem. For integrated circuits, the number of semiconductor elements per unit area of chip size, frequently expressed in terms of number of gate equivalents.

Pad
In IC technology, the bonding area.

Parallel gap solder
Passing a high current through a high resistance gap between two electrodes to remelt solder thereby forming an electrical connection.

Parallel gap welding
Type of resistance welding wherein electrodes contact the work from one side only. Mechanism by which bonding occurs in virtually always fusion. Process is well suited to welding component leads to planar surfaces such as IC leads to PC conductors.

Parallel testing
The testing of a number of devices at the same time (normally accomplished by mounting the devices on printed circuit boards which interface with the tester) as opposed to serial testing which tests one device at a time.

Parallelism (substrate)
The degree of variation in the uniform thickness of a given substrate.

Parallelity
Relationship of screen to work holder and print head in screen printing. Each should be parallel to one another in order to print accurately.

Parasitic device or element
An interaction between diffused circuit elements. A good example of a parasitic would be the collector series resistance (Rsat) of a transistor and the associated capacitance of the collector-to-substrate junction. In fact, the buried layer N+ diffusion is used to reduce collector resistance. The nature of current semiconductor technology makes it impossible to eliminate these parasitics. Where their effect on the circuit is significant, or when the circuit is designed to utilize these parasitics, they are shown on the schematic.

Parasite losses
Losses in a circuit often caused by the unintentional creation of capacitor elements in a film circuit by conductor crossovers.

Partial lift
A bonded lead partially removed from the bonded area.

Particle Count
A measurement scale for gas or liquid cleanliness, normally stated in parts per cubic foot. For example, a Class 10 working area would be one which contained no more than 10 particles greater than one micron in size per cubic foot of air.

Particle impact noise detection (PIND)
PIND testing equipment detects any loose foreign particles that may be present in a hermetic package. The package is placed on a shaker table where it is in intimate contact with an acoustic transducer that drives an ultrasonic amplifier.

Parts handling
Devices used to load and unload substrates during screen printing and drying operations.

Passivated region
A region covered by glass, Si02, nitride, or other protective material.

Passivation
The formation of an insulating layer directly over a circuit or circuit element to protect the surface from contaminants, moisture or particles. The surface coating of the die (usually thermally grown silicon dioxide, Si02) through which contact and diffusion windows are opened.

Passive components (elements)
Elements (or components) such as resistors, capacitors, and inductors which do not change their basic character when an electrical signal is applied. Transistors and electron tubes are active components.

Passive device
Devices such as resistors or capacitors which have no amplification or control characteristics.

Passive network
A circuit network of passive elements such as film resistors that are interconnected by conductors.

Passive substrate
A substrate for an integrated component which may serve as physical support and thermal link to a thick-film or thin-film integrated circuit, but which exhibits no transistance. Examples of passive substrates are glass, ceramic, and similar materials.

Passivism
Growth of an oxide layer on the surface of a semiconductor to provide electrical stability by isolating the transistor surface from electrical and chemical conditions in the environment. This reduces reverse-current leakage, increases breakdown voltages, and raises power dissipation rating.

Paste
Synonymous with "composition" and "ink" when relating to screenable, thick film materials.

Paste blending
Mixing a resistor pastes of different ohm/sq. value to create a third value in between those of the two original materials.

Paste soldering
Finely divided particles of solder suspended in a flux paste. Used for screening application onto a film circuit and reflowed to form connections to chip components.

Paste transfer
The movement of a resistor, conductor or solder paste material through a mask and deposition in a pattern onto a substrate.

Pattern
The outline of a collection of circuit conductors and resistors that defines the area to be covered by the material on a film circuit substrate.

Pattern/image
The open area in the screen through which the ink penetrates to become the printed image on the substrate, in screen printing.

PDA
Perfect Defect Allowable: The maximum percentage of a lot which may fail a 100% screening step without rejecting the lot. The PDA is predicted on the possibility that a failure mechanism which appears in an abnormally high percentage of a lot might appear at a later time in the balance of the lot. It should, therefore, not be used for screens where all defective devices can be observed and removed (such as internal visual or X-ray).

Peak firing temperature
The maximum temperature seen by a resistor or conductor paste in the firing cycle as defined by the firing profile.

Pedestal
A raised area above the rest of the surface of an eyelet; usually cylindrical in shape. It often functions as a heat sink. The mounting portion of a hybrid substrate when it is smaller than the main portion of the substrate.

Peel bond
Similar to lift-off of the bond with the idea that the separation of the lead from the bonding surface proceeds along the interface of the metallization and substrate insulation rather than the bond-metal interface.

Peel strength (peel test)
A measure of adhesion between a conductor and the substrate. The test is performed by pulling or peeling the conductor off the substrate and observing the force required. Units are oz/mil or lb/in of conductor width.

Percent defective allowable (PDA)
The maximum observed percent defective which will permit the lot to be accepted after the specified 100 percent test.

Perimeter sealing area
The sealing surface on an electronic package that follows the perimeter of the package cavity and defines the area used in bonding to the lid or cap.

Peripheral device
A device within a microprocessor device family whose function is required to support the operation of a CPU, microprocessor or microcontroller chip.

Phase
(As glassy phase, or metal phase) - Refers to the part or portion of materials system that is metallic or glassy in nature. A phase is a structurally homogeneous physically distinct portion of a substance or a group of substances which are in equilibrium with each other.

Phase diagram
State of a metal alloy over a wide temperature range. The Phase Diagram is used to identify eutectic solders and their solidus/liquidus point.

Photo etch
The process of forming a circuit pattern in metal film by light hardening a photo sensitive plastic material through a photo negative of the circuit and etching away the unprotected metal.

Photolithographic process
The process of forming a circuit pattern in metal film by light hardening a photo sensitive plastic material through a photo negative of the circuit and etching away the unprotected metal.

Photomask
A square, flat glass substrate, coated with a photographic emulsion or a very thin layer of metal, on which appear several hundred circuit patterns (each containing thousands of images). The patterns are exposed onto semiconductor wafers.

Photoresists and processing materials

These are light sensitive materials that are deposited as a uniform film on a wafer or substrate. The exposure of specific pattern is performed through masking operations. A photosensitive material which, after polymerization through selective exposure to ultraviolet light, resists chemical etching action.

Pig tail

A term that describes the amount of excess wire that remains at a bond site beyond the bond. Excess pig tail refers to remnant wire in excess of three wire diameters.

PIND

See Particle Impact Noise Detection.

Pinhole

A minute hole through a layer or pattern. Small localized areas in the oxide layer with low dielectric strength, usually as a result of contamination.

Pin-out

The listing or diagramatic description of the functions assigned to the various package pins of a hybrid or semiconductor device.

Pitch

Same as center-to-center spacing; .050" center-to-center spacing can be called .050" pitch.

Pits

Depressions produced in metal or ceramic surfaces by non-uniform deposition.

Planar process

Fabrication of MIC's and semiconductor devices using silicon dioxide as a masking agent and producing components on a single plane.

Planar structure

A flat-surfaced device structure with the junctions terminating on a single plane.

Plastic

A polymeric material, either organic (e.g. epoxy) or silicone used for conformal coating, encapsulation or overcoating.

Plastic device

A device wherein the package, or the encapsulant material for the semiconductor die, is plastic. Such materials as epoxies, phenolics, silicones, etc., are included.

Plastic encapsulation

Environmental protection of a completed circuit by imbedding it in a plastic such as epoxy or silicone.

Plastic shell

A thin plastic cup or box used to enclose an electronic circuit for environmental protection or used as a means to confine the plastic encapsulant used to imbed the circuit.

Platen
Plate which holds substrate during screen printing.

Plating
The deposition of a metal layer on a substrate surface by electrolytical or certain chemical means. The materials include gold, copper, solder, etc. The function of the metal plate vary, including corrosion protection, solderability enhancement, etch resist, bonding for lead frames, and electrical connection, among others.

Plug-in-package
An electronic package with leads strong enough and arranged on one surface so that the package can be plugged into a test or mounting socket and removed for replacement as desired without destruction.

PMOS
P-channel MOS; refers to the oldest type of MOS circuit where the electrical current is a flow of positive charges. See P-channel.

PN junction
In a semiconductor, a region of transition between P-type and N-type semiconducting material.

PNP transistor
Junction transistor formed by a thin slice of N-type semiconductor between two layers of P-type semiconductors. Amplification is by means of hole conduction. Also a junction transistor constructed by placing an N-type base between a P-type emitter and a P-type collector. The emitter is normally positive with respect to the base and the collector is normally negative with respect to the base.

Point-to-point wiring
An interconnecting technique wherein the connections between components are made by wires routed between connecting points.

Polishing
A mechanical finishing operation conducted upon solid state substrates to achieve smoothness and desired surface qualities. See Lapping.

Polycrystalline
A material is polycrystalline in nature if it is made of many small crystals. Alumina ceramics are polycrystalline, whereas glass substrates are not.

Polynary
A material system with many basic compounds as ingredients, as thick film resistor compositions. Binary indicates two compounds; ternary, three, etc.

Porcelainize
To coat and fire a metal with glass material, forming a hybrid circuit substrate.

Porosity
The ratio of solid matter to voids in a material.

Positive image
The true picture of a circuit pattern as opposed to the negative image or reversed image.

Positive temperature coefficient
The changing of a value in the positive direction with increasing temperature.

Post
See Terminal. See Land area.

Post curing
Heat aging of a film circuit after firing to stabilize the resistor values through stress relieving.

Post firing
Re-firing of a film circuit after having gone through the firing cycle. Sometimes used to change the values of the already fired resistors.

Post stress electrical
The application of an electrical load to a film circuit to stress the resistors and evaluate the resulting change in values.

Potting
Encapsulating of a circuit in plastic.

Power density
The amount of power dissipated from a film resistor through the substrate measured in watts/in^2.

Power dissipation
The dispersion of the heat generated from a film circuit when a current flows through it.

Power factor
The ratio of the actual power of an alternating or pulsating current as measured by a wattmeter to the apparent power as measured by an ammeter and voltmeter.

ppm
Parts-per-million. A measurement scale for defect rates in components or impurity levels in materials.

Precap
See Internal visual.

Prefired
Conductors fired in advance of the screening of resistors on a substrate.

Preform
To aid in soldering or adhesion, small circles or squares of the solder or epoxy are punched out of thin sheets. These preforms are placed on the spot to be soldered or bonded, prior to the placing of the object to be attached.

Pre-oxidizing
In package manufacturing, a process in which a controlled oxide is grown on the surface of the Kovar or other metal before glass sealing. In a matched seal, hermeticity is achieved through a molecular bond between the glass and the oxide.

Pre-seal visual
The process of visual inspection of a completed hybrid circuit assembly for defects prior to sealing the package.

Pressed alumina
Aluminum oxide ceramic formed by applying pressure to the ceramic powder and a binder to firing in a kiln.

Print and fire
A term sometimes used to indicate steps in the thick film process wherein the ink is printed on a substrate and is fired.

Print laydown
Screening of the film circuit pattern onto a substrate.

Print-print
Squeegee prints in both directions per substrate, in screen printing process.

Print stroke
Stroke of the squeegee in screen printing at which time link is forced through the pattern on the screen.

Printed-circuit
Circuit formed by depositing conducting material on the surface of an insulated sheet. Circuit components such as wiring, resistors, capacitors, inductors, etc., are etched on the sheet by various processes.

Printer
Process unit designed to accept, hold, and screen print a substrate in order that ink may be applied with extremely accurate and repeatable registration.

Printing
The same as print laydown.

Printing parameters
The conditions that affect the screening operation such as off-contact spacing, speed and pressure of squeegee, etc.

Probing
A term used to describe electrical testing that employs very finely-tipped probes applied sequentially to each of the finished dice of a wafer. Electrical test of semiconductor devices at the wafer level, so named because a metal probe is used to make electrical contact with each of the device's bonding pads.

Procuring activity
The organizational element (equipment manufacturer, government, contractor, subcontractor or other responsible organization) which contracts for articles, supplies or services and has the authority to grant waivers, deviations or exceptions to the procurement documents.

Production lot
Hybrid microcircuits manufactured on the same production line(s) by means of the same production techniques, materials, controls, and design. The production lot is usually date coded to permit control and traceability required for maintenance of reliability programs.

Profile (firing)
A graph of time versus temperature, or of position in a continuous thick film furnace versus temperature.

PROM
Programmable-read-only-memory; a ROM which requires a programming operation. A memory device whose stored data content is established on an individual device basis through a programming process (usually involving the blowing of fuse links on the surface of the die). Unlike EPROMs and EEPROMs, PROMS cannot be erased and reprogrammed.

Property
The physical, chemical or electrical characteristic of a given material.

Protective device
A circuit element fabricated on a semiconductor device (usually adjacent to the device input) for the purpose of protecting portions of the device circuitry from transient overstress. A good example of a protective device would be an input diode on a CMOS device, which absorbs electrostatic discharge to prevent that discharge from rupturing the gate oxide.

P-type semiconductor
An extrinsic semiconductor in which the hole density exceeds the conduction- electron density. By implication, the net ionized impurity concentration is an acceptor type. Semiconductor material in which the majority carriers are holes and are therefore positive.

Pull strength
The values of the pressure achieved in a test where a pulling stress is applied to determine breaking strength of a lead or bond.

Pull test
A test for bond strength of a lead, interconnecting wire or a conductor.

Pulse soldering
Soldering a connection by melting the solder in the joint area by pulsing current through a high resistance point applied to the joint area and the solder.

Punch-through
An unintended high current flow between two adjacent diffused areas created when sufficient voltage is applied to totally deplete both areas of majority carriers.

Purge

To evacuate an area or volume space of all unwanted gasses, moisture or contaminants prior to backfilling with an inert gas.

Purple plague

Defect-causing formation of gold-aluminum chemical compounds often produced when gold and aluminum are bonded. Purple in color, brittle, subject to degenerative failure, and sometimes compounded by inclusion of silicon. See Bimetallic contamination.

Push-off strength

The amount of force required to dislodge a chip device from its mounting pad by application of the force to one side of the device, parallel to the mounting surface.

Pyrolyzed (burned)

A material that has gained its final form by the action of heat is said to be pyrolyzed.

Q

Q
The inverse ratio of the frequency band between half-power points (band width) to the resonant frequency of the oscillating system. Refers to the electro-mechanical system of an ultrasonic bonder, or sensitivity of the mechanical resonance to changes in driving frequency.

Qualification testing
Testing performed one time only on a sample basis.

Qualifying activity
The government agency or original equipment manufacturer (OEM) responsible for determining vendor qualification status with respect to a given specification or series of specifications. In many cases the qualifying activity will be different from the procuring activity.

Quality
Conformance to a set of predetermined design and workmanship standards. Quality and reliability are not synonymous.

QCI
See Quality Conformance Inspection.

Quality conformance inspection
Ongoing sample testing on a periodic basis to determine conformance with the quality and reliability standards established in Qualification. See MIL-STD-883, Method 5005.

QML
Qualified manufacturers list - A list of those manufacturers and/or devices which have been qualified for a given program, specification or set of specifications.

QPL
Qualified products list - A list of those suppliers and/or devices which have been qualified for a given program, specification or set of specifications.

R

Rack plating
A method of electroplating in which the parts are affixed to a rigid rack.

Radiation hardening
Modification of the wafer fabrication process in order to improve a device's radiation tolerance characteristics.

Radiation hardness
The ability of a device to withstand radiation exposure without degradation or logic upset. Bipolar devices tend to be inherently harder than MOS devices.

Radiation screening
Testing of a device to determine its radiation tolerance. See MIL-STD-883, Method 2019.

Radiation susceptibility
The tendency inherent in a device to degrade as a result of exposure to radiation. MOS devices typically are more susceptible to radiation damage than bipolar devices.

Radiography
See X-ray.

Rad (SI)
The quantity of any type of ionizing radiation that will impart 100 ergs of energy per gram of silicon.

Radiographs
Photographs made of the interior of a sealed package by use of X-rays to expose the film.

RAM
Random access memory. A type of memory which offers access to storage locations within it by means of X and Y coordinates. A storage device in which the ability to access a randomly selected bit of stored data is independent of either the timing of the most recent access of that bit or the location of the most recently addressed bit. Data may be read nondestructively, but existing data is automatically erased when new data is written into a specific bit location. RAMS may be either static (that is able to retain data when the power supplies are not biased) or dynamic (that is unable to retain data unless a "refresh" voltage is periodically applied).

Random failures
Circuit failures which occur randomly with the overall failure rate for the sample population being nearly constant.

R-C network
A network composed only of resistors and capacitors.

Reactive metal
Metals that readily form compounds.

Read-and-Record
The recording, by individual device serial number, of the actual parametric values measured for that device at a specific electrical test point. Read-and-record can be done for device characterization, drift (delta) measurement, or temperature coefficient computation.

Real estate
The surface area of an integrated circuit or of a substrate. The surface area required for a component or element.

Re-bond
A second bonding attempt after a bond has been removed or failed to bond on the first attempt. The placement of a new bond on the same pad or post as a previously attempted bond. If the original bond has been removed, the new bond is still considered a rebond. A bond-off, that is, an extra bond placed at the edge of the post (never the pad) for the purpose of clearing the bonding machine, is not considered a rebond.

Re-bonding-over bond
A second bond made on top of a removed or damaged bond or a second bond made immediately adjacent to the first bond.

Reducing atmosphere
A protective atmosphere which prevents oxidation of metal parts while they are being fired. In glass-to-metal sealing, usually an exothermic atmosphere, in brazing nitrogen, hydrogen or a vacuum.

Reduction dimension
A dimension specified on enlarged scale matrices, between a pair of marks which are positioned in very accurate alignment with the horizontal center locations of two manufacturing holes, and their locally coincident targets. This dimension is used to indicate and verify the exact horizontal distance required between the two targets when the matrices are photographically reduced to full size.

Re-firing
Re-cycling a thick film resistor through the firing cycle to change the resistor value.

Re-flow soldering
A method of soldering involving application of solder prior to the actual joining. To solder, the parts are joined and heated, causing the solder to remelt, or reflow.

Refractory metal
Metals having a very high melting point such as molybdenum.

Register
A device which can store information, usually that contained in a small subset or word of the total within a digital computer system.

Registration
The degree of proper alignment of a circuit pattern on the substrate.

Registration marks
The marks used for aligning successive processing masks.

Reject number
For a sample test, the number of failed devices which will cause lot rejection. This will normally be one higher than the accept number.

Reliability
The anticipated lifetime of a device, how long it can be expected to "survive" in the user's system. This is normally defined as a failure rate (percent per 1000 hours) or as an MTBF (Mean Time Between Failures, expressed in hours).

Reinforced plastic
Plastics having reinforcing materials such as fiber glass imbedded or laminated in the cured plastic.

Resist
Material such as ink, paint, or metallic plating, used to protect the desired portions of the printed conductive pattern from the action of the etchant, solder, or plating.

Resistance to solvents
A test which requires immersion of sample devices in such solvents as trichlorotrifluoroethane and methylene chloride, followed by brushing to determine the durability of unit marking. See MIL-STD-883, Method 2015.

Resistance weld
Usually a plug-in package, which is sealed by resistance welding the entire perimeter simultaneously. Since plug-in packages are usually rather large for resistance welding, the process is made easier by adding a weld projection on the flange to give a uniform point of high resistance around the perimeter.

Resistivity
(e) A proportionality factor characteristic of different substrates equal to the resistance that a centimeter cube of the substance offers to the passage of electricity, the current being perpendicular to two parallel faces. It is defined by the expression R = eL/A where R is the resistance of a uniform conductor, L is its length. A is its cross sectional area, and e is its resistivity. Resistivity is usually expressed in ohm-centimeters.

Resistor drift
The change in resistance of a resistor through aging, and usually rated as % change per 1000 hours.

Resistor geometry
The film resistor outline.

Resistor overlap
The contact area between a film resistor and a film conductor.

Resistor paste calibration
The characterizing of a resistor paste for ohm/sq. value, TCR and other specified parameters by screening and firing a test pattern using the paste and recording the results.

Resistor termination
See resistor overlap.

Resolution
The degree of fineness or detail of a screen printed pattern (see line definition).

Rework
All work performed, other than testing, in a hybrid microcircuit (after initial circuit fabrication) on parts with known deficiencies so as to cause such parts or the entire microcircuit to comply fully with documented requirements.

Rheology
The science dealing with deformation and flow of matter.

Ribbon interconnect
A flat narrow ribbon of metal such as nickel, aluminum or gold used to interconnect circuit elements or to connect the element to the output pins.

Ribbon wire
Metal in the form of a very flexible flat thread or slender rod or bar tending to have a rectangular cross-section as opposed to a round cross-section.

Rigid coating
A conformal coating of thermosetting plastic that has no fillers or plasticizers to keep the coating pliable.

Rigid squeegee
Firm mounting of the screen printer squeegee blade and holder. Squeegee adjustment is more critical.

Risers
In a multilayer substrate, the conductive paths that vertically connect various levels.

ROM
Read-only-memory. A random access storage in which the data pattern is unchangeable after manufacture. A semiconductor device for storing data in permanent, nonerasable form, usually accomplished through the configuration of the metal mask pattern during wafer fabrication.

Rosin flux
A flux having a rosin base which becomes inactive after being subjected to the soldering temperature.

Rosin solder connection (rosin joint)
A soldered joint in which one of the parts is surrounded by an almost invisible film of insulating rosin, making the joint intermittently or continuously open even though the joint looks good.

Rotary (theta) motion
Angular (rotary) adjustment of image to substrate. Allows registration in angularity in addition to "X" and "Y" in screen printing (also called Theta motion).

S

Sagging or wire sag
The failure of bonding wire to form the loop defined by the path of the bonding tool between bonds.

Salt atmosphere
Exposure of sample devices to a salt rich environment to determine long-term durability of the package materials. See MIL-STD-883, Method 1009.

Sample
A device or devices randomly chosen from a lot of material. Sampling assumes that randomly selected devices will exhibit characteristics during testing that are typical of the lot as a whole.

Sample Plan
A statistically derived set of sample sizes, accept numbers, and/or reject numbers which will confirm that a given lot of materials meets established AQLs or LTPDs.

Sapphire substrates
Materials which provide a uniform dielectric constant, controlled orientation, thermal conductivity, and the single crystal surface desired for SOS, hybrid IC, and other microcircuit systems. The material may be grown directly in ribbons, tubes, filaments, and sheets.

Scaling
Peeling of a film conductor or film resistor from a substrate, indicating poor adhesion.

Scallop marks
A screening defect which is characterized by a print having jagged edges. This condition is a result of incorrect dynamic printing pressure or insufficient emulsion thickness.

Scavenging
Same as leaching.

SCD
See source control drawing.

Schematic
Diagram of a functional electronic circuit composed of symbols of all active and passive elements and their interconnecting matrix that forms the circuit.

Schottky barrier
A potential barrier formed between a metal and a semiconductor, frequently used in the creation of Schottky diodes.

Schwartzmanism
A correct technical dissertation in three syllable words that confuses mere mortals and only the erudite author has a chance of understanding.

Scored substrate
A substrate that has been scribed with a thin cut at the breaklines.

Screen
Tensioned mesh metal with an open pattern through which ink penetrates to place an image on the substrate. Screen is above and parallel to the substrate during screen printing.

Screen deposition
The laydown of a circuit pattern on a substrate using the silk screening technique.

Screen frame
A metal, wood or plastic frame that holds the silk or stainless steel screen tautly in place.

Screening
100% testing of a device, as opposed to sampling. Also the process whereby the desired film circuit patterns and configurations are transferred to the surface of the substrate during manufacture, by forcing a material through the open areas of the screen using the wiping action of a soft squeegee.

Screen printing, thick film
The art of depositing conductive, resistive, and insulating materials on a dielectric base. This deposition is made through selected open areas in screens with inks or pastes forced through the open areas of the screen by squeegee motion onto the substrate base. In some cases, masks instead of conventional mesh screens may be used.

Scribe grid
The area separating two adjacent dice on a wafer through which the scribing tool will pass during the separation of the wafer into individual dice.

Scribing
Scratching a tooled line or laser path on a brittle substrate to allow a wafer to be cleft or broken along the line, producing IC chips when all breaks are completed.

Scribing machines and tools.
Equipment used to separate wafers into individual devices, chips, or dice. This has been done by crude techniques similar to glass cutting, but is now accomplished by more efficient methods, using truncated pyramid diamond scribers, automated machines, conical tools, or lasers.

Scrubbing action
Rubbing of a chip device around on a bonding pad during the bonding operation to break up the oxide layer and improve wetability of the eutectic alloy used in forming the bond.

Seal ring
A metal piece, shaped somewhat like a picture frame, which is the top metallic surface of a glass package. The lid of the glass package can be soldered to the seal ring. On ceramic packages, the seal ring is often metallization rather than a piece of metal; it serves the same purpose.

Sealing
The process whereby the lid is fastened onto a cavity (or hermetic) type hybrid or semiconductor device. Sealing methods include solder (whereby a metal lid is soldered to a metal seal ring), weld (where a metal lid is welded to a metal package base), and glass (or ceramic) seal (where a ceramic lid is fastened to a ceramic base with reflowed glass).

Seam seal
A method of solder sealing packages; really a mechanized version of hand solder sealing. Solder preforms are usually used with reduced power (heat) on a seam welder. Two opposite points of the perimeter are sealed simultaneously.

Seam weld
A type of weld, used to seal the lid on a flat package or solid sidewall, by performing a series of overlapping spot welds simultaneously on the opposite sides of the lid. The welder's electrodes stay in constant contact with the lid and move continuously while the power supply is rapidly pulsed. A stepped lid is usually required. Sometimes called "roller welding".

Search height
The height of the bonding tool above the bonding area at which final adjustments in the location of the bonding area under the tool are made prior to lowering the tool for bonding.

Second bond
The second bond of a bond-pair made to form a conductive connection.

Second radius
The radius of the back edge of the bonding tool foot.

Second search
That period of machine cycle at which final adjustments in the location of the second bonding area (see second bond) under the tool are made prior to lowering the tool for making the second wire bond.

Selected Item drawing
Per MIL-STD-100, a drawing prepared for the purpose of procuring material which has been selected for parameters or characteristics differing from those to which the part is normally manufactured or tested.

Selective edge
Restricting the etching action on a pattern by the use of selective chemical which attack only one of the exposed materials.

Selective plating
A process through which different platings are deposited on two or more portions of the package. The most common instance is depositing 50 microinches of gold on the leads and 100 microinches of nickel on the package body.

Self-heating
Generation of heat with a body by chemical action. Epoxy materials self heat in curing due to exothermic reaction.

Self-passivating glaze
The glassy material in a thick film resistor that comes to the surface and seals the surface against moisture.

SEM
Standard electronic module A sub-assembly configuration format which meets a particular U.S. Navy set of specifications. This abbreviation is also used for scanning electron microscope. Scanning Electron Microscope Inspection, which allows magnification several magnitudes higher than could be achieved with an optical microscope. See MIL-STD-883, Method 2018. A scanning electron microscope is typically capable of resolution to 250 angstroms or better and magnification of greater than 20,000X.

Semiconductor
Solid or liquid electronic conductor, with resistivity between that of metals and that of insulators, in which the electrical charge carrier concentration increases with increasing temperature over some temperature range. Over most of the practical temperature range, the resistance has a negative temperature coefficient. Certain semiconductors possess two types of carriers, negative electrons and positive holes. The charge carriers are usually electrons, but there may also be some ionic conductivity. An element, such as silicon or germanium, that is the intermediate in electrical conductivity between the conductors and the insulators.

Semiconductor carrier
A permanent protective structure which provides for mounting and for electrical continuity in application of a semiconductor chip to a major substrate.

Semiconductor device
Electronic device in which the characteristic distinguishing electronic conduction takes place within a semiconductor.

Semiconductor integrated circuit (SIC)
The physical realization of a number of electric elements inseparably associated on or within a continuous body of semiconductor material to perform the function of a circuit.

Serialization
Application of a unique alphanumeric identifier to each unit of a lot of devices to afford traceability to variables data, Individual radiographs, etc.

Serpentine cut
A trim cut in a film resistor that follows a serpentine or wiggly pattern to effectively increase the resistor length and increase resistance.

Shear rate
The relative rate of flow or movement (of viscous fluids)

Shear strength
The limiting stress of a material determined by measuring a strain resulting from applied forces that cause or tend to cause contiguous parts of a body to slide relative to each other in a direction parallel to their plane of contact; the value of the force achieved when shearing stress is applied to the bond (normally parallel to the substrate) to determine the breaking load.

Shear tester
Shear testers are used to determine the integrity of a material or to test the adherence between two attached items. It is used for testing eutectic and epoxy die-bond strengths, and for adherence testing of gold wire ball bonds, gold and solder chip bumps, external lead frames, coined and welded gold electrical contacts, thick film plating, and more.

Sheet resistance
The electrical resistance of a thin sheet of a material with uniform thickness as measured across opposite sides of a unit square pattern. Expressed in ohms per square.

Shelf life
The maximum length of time, usually measured in months, between the date of shipment of a material to a customer and the date by which it should be used for best results.

Ship-to-stock
A system whereby a component user develops a statistical evaluation of the quality of his vendors' products, enabling him to use the products of those vendors whose quality is acceptable without performing additional product testing upon receipt at his plant. Also called dock-to-stock.

Short term overload
A circuit that has been overloaded with current or voltage for a period too short to cause breakdown of the insulation.

Shrink
The reduction of die size through conversion to a process within the same basic process family, but with smaller feature sizes.

SIC
Semiconductor integrated circuit.

Side brazed dip
A dual-in-line package with leads brazed to feedthroughs on the side of the package. Leads will normally come straight down rather than at angles as on other dual-in-line packages. No molded versions of this package are available.

Silicon
A brittle, gray, crystalline chemical element which, in its pure state, serves as a semiconductor substrate in microelectronics. It is naturally found in compounds such as silicon dioxide.

Silicon gate
A type of MOS in which the gate is made of silicon instead of metal. It is faster and denser than the metal-gate MOS. Also a MOS process fabricated with a polysilicon material as the gate electrode.

Silicon nitride
A compound of silicon and nitrogen deposited on the surface of silicon monolithic IC's to impart greater stability.

Silicon oxide
Silicon monoxide or dioxide or a mixture, the latter of which can be deposited on a silicon IC as insulation between metallization layers.

Silk screen
A screen of a closely woven silk mesh stretched over a frame and used to hold an emulsion outlining a circuit pattern and used in screen printing of film circuits. Used generically to describe any screen (stainless steel or nylon) used for screen printing.

Simple hybrid
A hybrid device having an Inner seal perimeter (i.e., a cavity perimeter) of less than 2 inches.

Single in-line package (SIP)
A plug-in package with one row of pins on .100" centers. Also known as a "sip". A package (either hermetic or molded) with all its leads emanating from one side of the package.

SIP
Abbreviation for single-in-line package.

Single print
One squeegee print stroke and flood return per substrate, in screen printing.

Sinking
Shorting of one conductor to another on multilayer screen printed circuits because of a downward movement of the top conductor through the molten crossover glass.

Sintering
Heating a metal powder under pressure and causing the particles to bond together in a mass. Alternately, subjecting a ceramic-powder mix to a firing cycle whereby the mix is less than completely fused and shrinks.

Skin effect
The increase in resistance of a conductor at microwave frequencies because of the tendency for current to concentrate at the conductor surface.

Skip bond
A bond placed between two metallization traces on a hybrid substrate.

Slash sheet
A military detail device specification giving the specific screening and electrical test requirements for a device or family of related devices. In a MIL-M-38510 part number, the first three digits after the slash indicate the slash sheet number.

Slice
A thin cross-section of a crystal such as silicon that is used for semiconductor substrates.

Slump
A spreading of printed thick film composition after screen printing but before drying. To much slumping results in loss of definition.

Slurry
A thick mixture of liquid and solids, the solids being in suspension in the liquid.

Small scale integration
A circuit of under 10 gates, generally involving one metallization level implementing one circuit function in monolithic silicon.

Smeared bond
A bond impression that has been distorted or enlarged by excess lateral movement of the bonding tool, or by the movement of the device holding fixture.

Snap-back
The return of a screen to normal after being deflected by the squeegee moving across the screen and substrate.

Snap-off
Distance from top of substrate in screen printing to bottom surface of screen. Squeegee must stretch screen this far to meet the substrate and deposit in. Set by "Z" motion adjustments.

Snapstrate
Scored large area substrate which, after screen printing, may be snapped or broken apart into smaller sized substrates.

Snugger
Device for automatically positioning and holding the substrate in proper position during the print cycle, in screen printing.

Soak time
The length of time a ceramic material (such as a substrate or thick film composition) is held at the peak temperature of the firing cycle.

Soft conversion
The process of changing a measurement language to mathematically equivalent metric unit without changing the physical configuration.

Soft error
An error of a nonpermanent nature introduced into a cell or cells of a memory device as a result of either voltage or current transients or radiation exposures. Although soft errors may be corrected, the data previously stored in the cell may not be retrievable.

Soft glass
The glass used in making compression seals; often Corning 9010 or the equivalent. It is a potash, soda, lime glass.

Soft solder
A low melting solder, generally a lead-tin alloy, with a melting point below 800 °F (425 °C).

Software
The instructions which program or sequence the functioning of the hardware of a device or system. These instructions may be contained internally (in ROM, for example) or externally (on tape, disc, or any other suitable memory medium).

Solder acceptance
Same as wetability or solderability.

Solder bumps
The round solder balls bonded to a transistor contact area and used to make connection to a conductor by face down bonding techniques.

Solder crown
Solder paste

Solder dam
A dielectric composition screened across a conductor to limit molten solder from spreading further onto solderable conductors.

Solder dip
Dipping of the leads of devices into molten solder in order to later facilitate soldering of the devices to circuit boards. Sometimes inaccurately referred to as "tin dip."

Solder glasses
Although it is not really solder, solder glass can be used in much the same way. It is inexpensive to use because it doesn't require any precious metal platings, but it is not as good in terms of yields nor as reliable as the conventional solders and generally requires more heat.

Solder immersion
A test that immerses the electronic package leads into a solder bath to check resistance to soldering temperatures.

Solder resist
A material used to localize and control the size of soldering areas, usually around component mounting holes. The solderable areas are defined by the solder resist matrix.

Solder seal
Semiconductor device sealing accomplished by soldering a metal lid to a metal seal ring.

Solder systems for bonding and welding
Processors for ceramic hybrid microcircuits, substrates, lead frames, micro assemblies, flat packs, wire memory arrays, ceramic headers, and magnet wire, where solder normally has been pretinned on the substrate or individual components, or solder pastes provide solder without the need for pretinning operations. Temperature controlled preheat, reflow, and cooling stages are involved, with reflow being almost instantaneous.

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

Solderability testing
Immersion of the leads of sample devices in solder, followed by visual Inspection to determine that the quality of the finish is such that it will accept an even coating of solder. See MIL-STD-883, Method 2003.

Soldering
A method of sealing microcircuit packages by using an easily fusible metal as the "glue". The solders usually used are tin/lead in a ration of 60/40, for tin-plated packages, and gold/tin, in a ratio of 80/20, for gold-plated packages. Sometimes called "soft solder" to distinguish it from "hard solder", which is brazing. There are three types of solder sealing used for hybrid packages; hand solder sealing, the more advanced peripheral solder sealing, and seam sealing. See those headings for further information.

Solid metal mask
A thin sheet of metal with an etched pattern used in contact printing of film circuits.

Solid phase bond
The formation of a bond between two parts in the absence of any liquid phase at any time prior to or during the joining process.

Solid sidewall
A type of plug-in package invented by Isotronics; it is unique in that it can be sealed with flatpack sealing equipment. There are two styles, one-piece and two-piece. The two-piece method is usually used for prototypes; a solid ring frame is brazed on an eyelet. The one-piece style consists of a single, solid drawn eyelet without the braze seam.

Solid-state circuit
Complete circuit formed from a single block of semiconductor material. See also monolithic integrated circuit.

Solid-state devices
Electronic components that convey or control electrons within solid materials - for example, transistors, semiconductor diodes, magnetic cores, etc.

Solid tantalum chip
A chip or leadless capacitor whose dielectric (Ta2O3)is formed with a solid electrolyte instead of a liquid electrolyte.

Solidus
The locus of points in a phase diagram representing the temperature, under equilibrium conditions, at which each composition in the system begins to melt during heating, or complete freezing during cooling.

Solubility
The ability of a substance to dissolve into a solvent.

Solvent
A material that has the ability to dissolve other materials.

Solvent resistant
A material that is unaffected by solvents and does not degrade when cleaned in solvents.

Source control drawing
Similar to a specification control drawing except that purchase of the specified devices from manufacturing sources other than those listed on the drawing is prohibited.

Source Inspection
Surveillance or inspection by a customer's quality representative or by a government inspector at the vendor's facility of material being assembled or screened by that vendor.

SOS
Silicon-on-sapphire transistor device. Silicon is grown on a passive insulating base (sapphire) and then selectively etched away to form a solid state device.

Spacings
The distance between adjacent conductor edges.

Specific gravity
The ratio of the weight of a given volume of a substance to the weight of an equal volume of water at a temperature of 4°C.

Specific heat
The quantity of heat required to raise the temperature of one gram of a substance one degree centigrade.

Specimen
A sample of material, device or circuit representing the production lot removed for test.

Spikes
See curls.

Spinel
A single crystal magnesium aluminum oxide substrate used in integrated circuits.

Split tip electrode
Same as parallel-gap electrode.

Sputtering
A method of depositing a thin film or material onto a substrate. The substrate is placed in a large demountable vacuum chamber having a cathode made of the metal or ceramic to be sputtered. The chamber is then operated so as to bombard the cathode with positive ions. As a result, small particles of the material fall uniformly on the substrate. Also a method of producing thin films by freeing molecules from a solid source through ionic bombardment in order to deposit them on a nearby surface.

Sputtering targets
These are usually in the form of simple circular or rectangular plates, comprised of a variety of materials, and bombarded by gas ions that transfer their momentum to particles of the target, ejecting them into the vacuum chamber that houses the operation. These particles are then deposited in a thin film on strategically located substrates.

SQC
See Statistical qualify control.

Squashout
The deformed area of a lead which extends beyond the dimensions of the lead prior to bonding.

Squeegee
Hard, flexible blade with a precision edge which, with applied pressure, forces or pushes ink through the screen in screen printing.

Squeegee pressure
Downward force exerted upon the screen and substrate by the squeegee during screen printing.

Squeegee speed
Rate of speed at which the squeegee is driven across the screen during screen printing.

SS
Stainless steel; for hybrid circuit packages, #304L is usually used. It's often specified for non-magnetic applications.

SSI
Small Scale Integration. SSI devices are those that contain leas than 12 gate equivalents.

Stabilization bake
Placement of devices in a chamber at elevated temperature (normally 150°C) without electrical bias in order to teat the construction of the devices. Some times this is performed prior to seal in order to bake out impurities on the die surface. See MIL-STD-883, Method 1008. Stabilization bake differs from high temperature storage only in that it is typically of shorter duration.

Stacked bond
A rebond placed directly over a previous bond. Also called a compound bond.

Staggered leads
Leads emanating from the same side of a package but bent in alternating directions such that they will insert into two or more parallel lines of mounting holes.

Staggered pin pattern
A pin pattern for plug-in packages in which the alternate pin centers are offset to allow greater pin density and make wire bonding easier.

Stainless steel screen
A stainless steel mesh screen stretched across a frame and used to support a circuit pattern defined by an emulsion bonded to the screen.

Stair step print
A print which retains the pattern of the screen mesh at the line edges. This is a result of inadequate dynamic printing pressure exerted on the paste or insufficient emulsion thickness coating the screen.

Standard deviation
A statistical term that helps describe the likely value of parts in a lot or batch of components in comparison with the lot's average value. Practically all of a lot will fall within +3 standard deviations of the average value if it is a normal distribution.

Standoff
A device that elevates a package above its mounting surface. Standards can be made of three materials: Metal, ceramic or glass. Metal standoffs can be solid and brazed in place or they can be made by displacing a portion of the package bottom. Ceramic standoffs are normally brazed into place. Glass standoffs can either be anchored on the outside or they can extend partially or all the way into the package. Glass standoffs are the least expensive. Both ceramic and glass standoffs provide electrical isolation.

Static RAM
See RAM.

Statistical quality control
A quality control system utilizing statistical analysis of process defect data to detect quality trends on a real time basis.

Steatite
Ceramic material composed mainly of a silicate of magnesium, used as a circuit substrate.

Stencil
A thin sheet material with a circuit pattern cut into the material. A metal mask is a stencil.

Step
To use the step-and-repeat method.

Step-and-repeat
A process wherein the conductor or resistor pattern is repeated many times in evenly spaced rows onto a single film or substrate.

Stepped lid
A flat lid with a flange on the outside of the lid to make it self-locating. The flange also aids in welding.

Stitch bond
A bond made with a capillary-type bonding tool when the wire is not formed into a ball prior to bonding.

Stitch bonding
A bonding technique whereby the tip of the bonding wire is fed under the bonding head, which then applies heat and pressure to "stitch" the wire to the pad or post. Frequently several stitches will be employed on the same bond. Stitch bonding can be visually differentiated from ultrasonic bonding because the impressions normally run across the bond rather than along its length.

Stitch weld
A series of repetitive, overlapping spot welds, similar to sewing, with the upper electrode making repeated contact, used to seal other methods of welding. It gives good yields and is simple to accomplish. It is usually used for closing flag packages and solid sidewall plug-ins with flat lids, sometimes for flange-against-flange style plug-ins.

Stratification
The separation of non-volatile components of a thick film into horizontal layers during firing, due to large differences in density of the component. It is more likely to occur with a glass containing conductor paste, and under prolonged, or repeated firing.

Stray capacitance
Capacitance developed from adjacent conductors separated by an air dielectric or dielectric material.

Stress-free
The annealed or stress relieved material where the molecules are no longer in tension.

Stress relieve
A process of re-heating a film resistor to make it stress-free.

Stripline
A microwave conductor on a substrate.

Stylus
A sharp pointed probe used in making an electrical contact on the pad of a leadless device or a film circuit.

Subcarrier substrate
A small substrate of a film circuit which is mounted in turn to a larger substrate.

Substrate
The supporting material upon or within which the elements of a microcircuit or integrated circuit are fabricated or attached. Also the physical material upon which an integrated circuit is fabricated or assembled. For a monolithic device, this would be the silicon of the chip; for a hybrid it would be the alumina or ceramic surface upon which the die and other elements are deposited.

Substrate bond
See Skip bond.

Subsystem
A part or division of a system which in itself has the properties of a system.

Surface conductance
Conductance of electrons along the outer surface of a conductor.

Surface diffusion
The high temperature injection of atoms into the surface layer of a semiconductor material to form the junctions. Usually a gaseous diffusion process.

Surface finish
The peaks and valleys in the surface of a substrate rated in microinches/inch deviation.

Surface nucleation
The change in phase or state of the surface on a substrate.

Surface resistivity
The resistance to a current flow along the surface of an insulator material.

Surface states
Extra donors, acceptors, or traps, usually undesired, which may occur on a semiconductor surface because of crystal imperfections or contamination. These may vary with time.

Surface tension
An effect of the forces of attraction existing between the molecules of a liquid. It exists only on the boundary surface.

Surface texture
The smoothness or lack of it on the surface of a substrate.

Surfactant
A contraction for the term surface-active agent.

Surveillance
Random witnessing of testing or screening of devices to determine that the material meets all applicable requirements.

Swimming
Lateral shifting of a thick film conductor pattern on molten glass crossover patterns.

T

Tacky state
A material is in the "Tacky State" when it exhibits an adhesive bond to another surface.

Tail (of the bond)
The free end of wire extending beyond the bond impression of a wire bond from the heel.

Tail pull
The act of removing the excess wire left when a wedge or ultrasonic bond is made.

Tantalum capacitor
Capacitors that utilize a thin tantalum oxide layer as the dielectric material.

Tape alumina
Alumina (substrates) made by tape casting of slurry into strips of green alumina of a pre-determined thickness. This is followed by stamping, cutting in the green state, then firing.

Taper testers
A taper tester is used to test one aspect of the dimensional integrity of wafers. Taper results when the two faces of the water under test are not parallel.

Tarnish
Chemical accretions on the surface of metals, such as sulfides and oxides. Solder fluxes have to remove tarnish in order to allow wetting.

TCR
Temperature coefficient of resistance.

Tear strength
Measurement of the amount of force needed to tear a solid material that has been nicked on one edge and then subjected to a pulling stress. Measured in pounds per inch.

Temperature aging
Aging or stressing a film circuit in an elevated temperature over a period of time.

Temperature coefficient of capacitance (TCC)
The amount of capacitance change of a capacitor with temperature - commonly expressed as the average change over a certain temperature range in parts per million per degree Centigrade (ppm per°C).

Temperature coefficient of resistance
The amount of change in the resistance of a material per degree of temperature rise.

Temperature cycle
A test whereby devices are stored for short periods (15 minutes) alternately at high and low temperatures in gas filled chambers, with a maximum transfer time between chambers of one minute. Normally 10 cycles are performed from -65 to +150°C. This stresses device assembly because of the different thermal coefficients of expansion of the various materials used. See MIL-STD-883, Method 1010.

Temperature cycling
An environmental test where the film circuit is subjected to several temperature changes from a low temperature to a high temperature over a period of time.

Temperature excursion
The extreme temperature differences seen by a film circuit under operating conditions.

Temperature tracking
The ability of a component to retrace its electrical readings going up and down the temperature scale.

Tensile strength
The pulling stress which has to be applied to a material to break it, usually measured in pounds per square inch (psi).

Terminal
A metal lead used to provide electrical access to the inside of the device package.

Test pattern
A circuit or group of substrate elements processed on or within a substrate to act as a test site or sites for element evaluation or monitoring of fabrication processes.

Thermal compression bonding
Process of diffusion bonding in which two prepared surfaces are brought into intimate contact, and plastic deformation is induced by the combined effect of pressure and temperature, which in turn result in atom movement causing the development of a crystal lattice bridging the gap between facing surfaces and resulting in bonding.

Thermal conductivity
The rate at which a given material conducts heat, expressed in calories per square centimeter per centimeter per cross-section per degree Centigrade. Rates of thermal conductivity for some materials commonly used in hybrid packaging are:

Material	Thermal Conductivity
CRS (C1010)	.12
Alloy #52	.04
Kovar	.0395
Corning 7052 (glass)	.0028
96% Alumina	.084

Material	Thermal Conductivity
98% Beryllia	.49 at 20°C .37 at 100°C
Epoxy	.0003 - .0006
Alumina filled epoxy	.0009 - .0011
Beryllia filled epoxy	.021 -.073
Teflon	.0006
Aluminum	.480
Copper	.918

Thermal design
The schematic heat flow path for power dissipation from within a film circuit to a heat sink.

Thermal drift
The drift of circuit elements from nominal value due to changes in temperature.

Thermal drop
The difference in temperature across a boundary or across a material.

Thermal expansion
The coefficient of thermal expansion is a measurement of the rate at which a given material expands as heat increases, expressed as a factor of 10^{-7} cm per °C. Thermal expansion rates are important to the hybrid circuit manufacturer, when considering the method of substrate attach. They are also important to the package manufacturer, since rates of materials must be closely matched for hermeticity to be achieved in a matched seal or mismatched properly to make comparison seals. Average coefficients of thermal expansion for materials commonly used in hybrid packages are:

Material	Thermal Coefficient
C1010	140
Alloy #52	90
Kovar	55
"Hard Glass"	55
Alumina	50
Beryllia	70
Copper	160
Stainless Steel	160

Thermal gradient
The plot of temperature variances across the surface or the bulk thickness of a material being heated.

Thermal mismatch
Differences of thermal coefficients of expansion of materials which are bonded together.

Thermal noise
Noise which is generated by the random thermal motion of charged particles in an electronic device.

Thermal resistance
Normally stated in terms of °C/W, it is the indicator of the package's ability to dissipate the heat generated by the chip during operation. ThetaJc is the indicator of the chip's ability to pass the heat generated by the semiconductor junctions to the package, that is the thermal resistance between the semiconductor junction and the case; theta JA is the thermal resistance between the semiconductor junction and the ambient environment, or the indicator of the case's ability to pass chip heat into the ambient air.

Thermal secondary breakdown
Burnout of a semiconductor junction area as the result of a reverse-bias voltage or current induced thermal runaway condition.

Thermal runaway
A condition wherein the heat generated by a device causes an increase in heat generated. This spiraling rise in dissipation usually continues until a temperature is reached that results in destruction of the device.

Thermal shift
The permanent shift in the nominal value of a circuit element due to heating effect.

Thermal shock
Similar to Temperature Cycle except that the environments are liquid, and the transfer is immediate. Normally performed for 15 cycles from 0 to +100°C, this is a much more severe stress of the package seal and is normally employed only on a sample basis. See MIL-STD 883, Method 1011. Also a condition whereby devices are subjected alternately to extreme heat and extreme cold. Used to screen out processing defects.

Thermistor
A semiconductor device, the electrical resistance of which varies with the temperature, its temperature coefficient of resistance is high, nonlinear, and usually negative.

Thermocompression bonding
A process involving the use of pressure and temperature to join two materials by interdiffusion across the boundary. See Ball bonding.

Thermoplastic
A substance which becomes plastic (malleable) on being heated; a plastic material which can be repeatedly melted or softened by heat without change of properties.

Thermoswaging
Heating a pin that is inserted in a hole and upsetting the hot metal so that it swells and fills the hole, thereby forming a tight bond with the base material.

Thick film

Any coating thickness greater than 5µ (5 x 10^{+4} angstroms), typically formed by applying a liquid, solid, or paste coating through a screen or mask in a selective pattern. Conductive, resistive, and/or capacitive passive network deposited on a substrate using a metallic or resistive film which is more than five microns in thickness.

Thick-film circuit

Microcircuit in which passive components, of a ceramic-metal composition, are formed on a suitable substrate by screening and firing, and discrete active elements are attached separately.

Thick film hybrid integrated circuits

The physical realization of a hybrid integrated circuit fabrication on a thick film network.

Thick film network

A network of thick film resistors and/or capacitors interconnected with thick film conductors on a ceramic substrate, formed by screening and firing.

Thick-film resistor

Fixed resistor whose resistance element is a film well over one-thousandth of an inch thick.

Thick film resistor, conductor, and dielectric compositions

The principle materials for making thick film circuits, available in paste form and consisting of mixtures of metal, oxide and glass powders.

Thick film technology

The technology whereby electrical networks or elements are formed by applying a liquid, solid, or paste coating through a screen or mask in a selective pattern onto a supporting material (substrate) and fired. Films so formed are usually 5 micrometers or greater in thickness.

Thin film

Any coating thickness less than 5µ (5 x 10^{+4} angstroms), typically formed by vacuum depositing or sputtering. Conductive, resistive, and/or capacitive passive network deposited on a substrate using a metallic or resistive film which is less than five microns in thickness (<50,000 angstroms).

Thin-film circuit

Integrated circuit consisting of a passive substrate on which the various passive elements (resistors and capacitors) are deposited in the form of thin patterned films of conductive or nonconductive material. Active components (transistors and diodes) are attached separately as individually packaged devices or in unpackaged (chip) form, or may be formed integrally by thin-film techniques. See also hybrid thin-film circuit.

Thin film deposition, chemical vapor type

The CVD technique involves a decomposition and reaction between gases on the surface of a heated substrate such that a solid layer is nucleated and grown. Metals are generally derived from the decomposition of the metal halides. Insulators may be formed by reacting metal halides with oxygen (oxides), ammonia (nitrides), diborane (borides), etc.

Thin film deposition materials, conductors and resistors
Metals such as aluminum, gold, chromium, nickel, platinum, tungsten, alloys, and cermets deposited as electrical conductors and resistors on silicon or other substrates.

Thin film deposition materials, inorganic dielectrics
Film compounds produced by various vacuum evaporation processes and deposited on substrates to perform electrical functions. Examples include silicon monoxide, ZnS, CaF, SiO2, Al2O3, Si3N4, and other chemical compounds.

Thin film deposition materials, organic dielectrics
Insulating film compounds produced when organic vapors are heated under conditions in which polymerization and deposition occur. Examples are parylene, butadene, acrolein, and divinyl benzene.

Thin film deposition materials, semiconductor
Polycrystalline films deposited by vacuum or flash evaporation to produce high purity single crystal silicon or other semiconductor substances.

Thin film deposition, sputtering type
Evaporation produced by ion bombardment of the source material, known as cathode-sputtering.

Thin film hybrid integrated circuits
The physical realization of a hybrid integrated circuit fabricated on a thin film network.

Thin film integrated circuit
The physical realization of a number of electric elements entirely in the form of thin films deposited in a patterned relationship on a structural supporting material.

Thin film network
A resistor and/or capacitor and conductor network formed on a single substrate by vacuum evaporation and sputtering techniques.

Thin film technology
The technology whereby electronic networks or elements are formed by vacuum evaporation or sputtering films onto a supporting material (substrate). Films so formed are less than 5 and usually in the order of 0.3 to 1.0 micrometers in thickness.

Thixotropic
A fluid that gets less viscous as it is stirred (or moved) is pseudoplastic. The term thixotropic is sometimes applied to these fluids, (e.g. most thick film inks).

Threshold voltage
The voltage level at which a device will recognize a falling or rising voltage as a change in logic state.

Through-hole-mounting
A mounting technique for semiconductor packages in which the device leads are passed through holes in the mounting surface. Attachment of leads may be accomplished with solder or with other mechanical means.

Throw-away module
A functional circuit in a modular form factor that is considered expendable and will not be repaired because of its low cost.

Tie bar
The part of an etched or stamped lead frame that joins the ends of the leads together. Also sometimes called the "commoning bar".

Tin dip
A term commonly misapplied to the solder dipping of device leads. See Solder dip.

Tin lead
A solder, usually 60% tin and 40% lead, but sometimes 63% tin and 37% lead, normally used in solder sealing packages that are tin plated.

Tin plating
Usually deposited per MIL-T-10727. There are two types of tin plating commonly used in hybrid circuit packages. Bright tin is a deposit of pure tin, which is very shiny and smooth, over copper. Hot fat flowed tin is dull tin, deposited over copper and then heated in hot fat to flow it, forming a shiny, smooth surface. Both methods provide the same general characteristics. Bright tin is significantly less expensive and is probably more reliable, since there is no chance of hot fat "plugging" defects in the glass seals and thus possibly confusing the results of the final hermetic check.

Tinned
Literally, coated with tin, but commonly used to indicate coated with solder.

Tinning
To coat metallic surfaces with a thin layer of solder.

Tip
That portion of the bonding tool which deforms the wire to cause the bond impression.

TIR
"Total Indicated Reading"; the total amount of variation, both positive and negative, from the correct dimension.

Tomb stone
When a small rectangular or cylindrical component has flipped to a vertical position during reflow.

Tooling
Vacuum holes, grooves, and locating pins on the tool plate surface dedicated to a certain size substrate in order to position and hold the substrate during the print cycle of screen printing.

TO package
Can-type IC chip configuration, an out growth of the original TO transistor package. Most common are the TO-5, TO-18, and TO-47. The IC chip is mounted within the package, interconnected to terminals on the can, and then hermetically sealed. TO stands for transistor outline.

Toe
See tail (of the bond).

Top hat resistors
Film resistors having a projection out one side allowing a notch to be cut into the center of the projection to effectively form a serpentine resistor and thereby increase the resistivity.

Topography
The surface condition of a film - bumps, craters, etc.

Topology
The surface layout design study and characterization of a microcircuit. It has application chiefly in the preparation of the artwork for the layout masks used in fabrication.

Toroids
A helical winding on a ring shaped core (doughnut shaped coil). A popular form used for inductors and transformers in hybrid microcircuits because of their volumetric efficiency compared to other shapes.

Torque test
A test for determining the amount of torque required to twist off a lead or terminal.

Total dose radiation
Accumulated radiation due to prolonged exposure to a radiation field (as encountered, for example, by satellites in the earth's Van Allen belt).

Tracking
Two similar elements on the same circuit that change values with temperature in close harmony are said to track well. Tracking of different resistors is measured in ppm/degree C (difference). Tracking is also used reference to temperature hysteresis performance and potentiometer repeatability.

Transducer
A device actuated by one transmission system and supplying related energy to another transmission system.

Transfer method
Molding circuit modules by transferring molten plastic into a cavity holding the circuit by using a press.

Transistance
The characteristic of an electric element which controls voltages or current so as to accomplish gain or switching action in a circuit. Examples of the physical realization of transistance occur in transistors, diodes, saturable reactors, limistors, and relays.

Transistor
Active semiconductor device with three or more electrodes.

Transistor base
Region which lies between an emitter and a collector of a transistor, into which minority carriers are injected.

Transistor chip
Uncapsulated transistor element of very small size used in microcircuits.

Transistor testers
Equipment and instruments which detect or measure leakage current, breakdown voltage, gain, or saturation voltage. Some testers are computer operated.

Trapezoidal distortion
Distortion which can occur during photo reduction. As a result, a square shape in the original master will be transformed into a trapezoid at the reduced positive.

Triboelectric effects
The creation of electrostatic charge that occurs when two surfaces contact and then separate, leaving one positively charged and the other negatively charged.

Trim and form
The step in the assembly process for devices assembled on a lead frame (such as flatpacks and dual-in-line packages) where the lead frame is trimmed off and the leads bent or formed into their specified positions.

Trim notch
The notch made in a resistor by trimming to obtain the design value. See KERF.

Trimming
Removal of film resistor material in order to increase the resistance to a certain value. Two types of equipment are used for this purpose. The air abrasive jet trimming system (AJT) depends on a precisely controlled stream of abrasive particles to carve away small portions of a thick film resistor. Laser systems are often used for both thick and thin films. With lasers, the material is burned away.

Truth table
For a logic device, a table showing the output logic states that would result from each of the possible input logic combinations the device is designed to accept.

Turreted pin
A headed pin which also has an upset. This style of pin is often used in power packages, since the space between the two increased diameters provides good mechanical anchorage and positive positioning of a large wire.

U

ULSI
Ultra Large Scale Integration. A term applied to devices with complexity levels in excess of 10,000 gates.

Ultrasonic bond
A contact area where two materials are joined by means of ultrasonic energy and pressure.

Ultrasonic bonding
A bonding technique which utilizes a bonding head to apply ultrasonic vibration to the bonding wire and to convert the vibration to heat through pressure and through the friction between the wire and the pad created by the scrubbing action of the head. Since this technique requires no external heating, it results in minimal oxidation of aluminum bond wire and bonding pads. Used normally with aluminum wire, this is the most commonly employed bonding technique.

Ultrasonic cleaning
A method of cleaning that uses cavitation in fluids caused by applying ultrasonic vibrations to the fluid.

Ultrasonic power supply
An electronic high frequency generator that provides ultrasonic power to a transducer.

Ultrasonic wire bonder
Equipment unit which fastens fine wire onto substrate by use of ultrasonic energy.

Uncased device
A chip device.

Under deformed
Insufficient deformation of the wire by the bonding tool occurring during the bonding operation.

Undercutting
Inward sloping of die metallization or silicon such that its upper surface is wider than its base.

Under glaze
A glass or ceramic glaze applied to a substrate prior to the screening and firing of a resistor.

Unipolar
Devices or processes in which current carrying areas and substrates are of similar polarities, usually MOS devices.

Unit under test (UUT)
Any system, set subsystem, assembly, or subassembly undergoing testing.

Universal lead frame
Lead frame in which flag is not supported by any lead.

Upset pin

A pin which has had a portion of its middle forced outward to create a bulge. This type of pin has greater bend strength than the ordinary pin, and it will bend only at a predetermined point, just below the upset.

UV curing

Polymerizing, hardening, or cross linking a low molecular weight resinous material in a wet coating or ink, using ultraviolet light as an energy system

V

Vacuum bake
After processing unsealed circuits or packages, a manufacturer performs a bakes in a special oven, under great reduced atmospheric pressure, to ensure that no liquid has been entrapped. This procedure greatly increases the probability of passing the internal water vapor test, improves the accuracy of the helium leak check, and also stabilizes the electrical circuit.

Vacuum deposition
Deposition of a metal film onto a substrate in a vacuum by metal evaporation techniques.

Vacuum evaporation
The creation of thin films by vaporizing the film substrate and allowing its deposition onto a substrate through mask openings.

Vacuum pickup
A handling instrument with a small vacuum cup on one end used to pick up chip devices.

Vapor phase
The state of a compound when it is in the form of a vapor.

Variables data
Recorded parametric or delta values, traceable to individual devices, as opposed to lot data (or attributes data).

Varistor
A two-electrode semiconductor device with a voltage-dependent nonlinear resistance which fails significantly as the voltage is increased.

Varnish
A protective coating for a circuit to protect the elements from environmental damage.

Vehicle
A thick film term that refers to the organic system in the paste.

VHDL
VHSIC hardware descriptive language.

VHSIC
Very High Speed Integrated Circuits. The acronym applied to the Department of Defense sponsored research and development program to advance the state of the art in semiconductor device speeds, densities, power consumption, and system effectiveness.

Via
A vertical conductor or conductive path forming the interconnection between multilayer hybrid circuit layers.

Vibration variable frequency
A test which applies vibration to devices on a sample basis (since it is considered destructive) in order to subject them to the maximum possible construction stress. The device is vibrated with simple harmonic motion through a range of frequencies. See MIL-STD-883, Method 2007.

Vintage control number
An alpha-numeric code relating to changes made on manufactured products. The vintage control code generally follows the item part number.

Viscosimeter (viscometer)
A device that measures viscosity. viscometers for thick film compositions must be capable of measuring viscosity under conditions of varying shear rates.

Viscosity
A term used to describe the fluidity of material, or the rate of flow versus pressure. The unit of viscosity measurement is poise - more commonly centipoise. Viscosity varies inversely with temperature.

Viscosity coefficient
The coefficient of viscosity is the value of the tangential force per unit area which is necessary to maintain unit relative velocity between two parallel planes unit distance apart.

Vitreous
A term used in ceramic technology indicating fired characteristics approaching being glassy, but not necessarily totally glassy.

Vitreous binder
A glassy material used in a compound to bind other particles together. This takes place after melting the glass and cooling.

Vitrification
The reduction of porosity in a ceramic product through the formation of a glassy bond.

VLSI
Very Large Scale Integrated circuits -- VLSI devices are generally accepted to be those that contain more than 10,000 gate equivalents, but less than 100,000.

Voltage gradient
The voltage drop (or change) per unit length along a resistor or other conductive path.

Voltage rating
The maximum voltage which an electronic circuit can sustain to insure long life and reliable operation.

Volume resistivity
A 1-cm cube of material will have resistance equal to the material's resistivity. The qualification "volume" adds nothing, but is sometimes used so that "resistivity" and "resistance" will not be confused (typically measured in ohm-cm).

W

Wafer
A slice of a semiconductor crystal ingot used as a substrate for transistors, diodes and monolithic integrated circuits.

Wafer and die sorters
Equipment which automates the testing and sorting of semiconductor devices from wafer form.

Wafer fabrication
The process whereby semiconductor elements are manufactured on the surface of silicon wafers.

Wafer handling equipment
Equipment used for processing silicon wafers using methods which include batch processing in a common carrier, air bearing single wafer processing, and a combination of batch and single wafer processing.

Wafer lot
A single lot of wafers processed through all processing steps including metallization together. A wafer run may consist of more than one device type, where the various device types differ only in the metallization pattern employed.

Wafer probe
See Sort.

Wafers
Slices of semiconductor crystal materials used as substrates for monolithic IC's, diodes, and transistors.

Warp & woof
Threads in a woven screen which crosses each other at right angles.

Warpage
The distortion of a substrate from a flat plane.

Waves
Any disturbance that advances through a medium with a speed determined by properties of the medium.

Waviness
One or a series of elevations or depressions or both, which are readily noticeable and which include defects such as buckles, ridges, etc.

Webbing
The metal between the extreme top of the glass seals and the seal surface of a flatpack; a critical dimension for flat packages that are to be welded shut. To avoid thermal shock to the glass seals during welding, most manufacturers recommend certain minimums for the webbing. For example, on a Kovar flat package with a wall thickness of .040", we recommend that the webbing be .040" min. for seam welding with Kovar stepped lids having a flange thickness of .005", or for stitch welding with Kovar flat lids .010" thick. As the wall thickness or the package material changes, the recommended minimum webbing also changes. In a plug-in package, webbing is the amount of metal between the holes for the glass seals or some other designed area of the package.

Wedge bond
A bond made with a wedge tool. The term is usually used to differentiate thermocompression wedge bonds from other thermocompression bonds (almost all ultrasonic bonds are wedge bonds).

Wedge bonding
See Ultrasonic bonding (although Stitch bonding is occasionally called wedge bonding as well).

Weld protection
A type of plug-in package which is sealed by resistance welding. The cover has a flange and the pyramid-shaped bead of metal around the header eyelet flange forms a point of high resistance, making the weld possible.

Welding
Joining of two or more pieces of a metal or metals by fusing them together. In welding microcircuit packages, it must be borne in mind that any joining or sealing technique which does not raise the metals to their eutectics is not true welding. For instance, the eutectic of Kovar is approximately 1,500 degrees, and a welding process involving Kovar must reach that temperature. There are three welding methods commonly used for sealing all- metal packages: Resistance, seam, and stitch. Laser and electron-beam welding are also used, to a lesser extent. A unique advantage of all-metal packages is that they can be welded shut, which eliminates the need for precious metal plating on the lid or cover. See Resistance weld, Seam weld, and Stitch weld.

Weld seal
Semiconductor device sealing accomplished by welding a metal lid to a metal package (typically employed for metal can devices).

Wet-process benches
These are benches or stations used for wafer processing. Because of the hazardous materials (acids) that are used, they should be designed with personal safety and contamination control foremost.

Wetting
The spreading of molten solder on a metallic surface, with proper application of heat and flux.

Wicking
The flow of solder along the strands and under the insulation of stranded lead wires.

Wire bond
The fastened union point between a conductor or terminal and the semiconductor die.

Wire bonding
The method used to attach very fine wire to semiconductor components to interconnect these components with each other or with package leads.

Wire clamp
A device designated to hold the wire during the cut-off operation.

Wire, semiconductor lead
Fine wire used to connect semiconductor chips to substrate patterns, packages, other chips, etc.. Usually made from an aluminum alloy or gold.

Wire spool
The wire magazine.

Wobble bond
A thermocompression, multi-contract bond accomplished by rocking (or wobbling) a bonding tool on the beams of a beam lead device.

Worst case analysis
The analysis of a circuit function under tolerance extremes of temperature, humidity, etc., to determine the worst possible effect on the output parameters.

Woven screen
A screen mesh used for screen printing usually of nylon or stainless steel or possibly silk

X

X axis

The horizontal or left-to-right direction in a two-dimensional system of coordinates. X-X signifies one direction followed in a step-and-repeat method.

"X" motion.

Registration adjustment left and right of the screen pattern to the substrate, in screen printing.

X-ray

Radiographic analysis of the construction of a device. This is a less useful technique for devices with aluminum bond wires since only die attach and seal defects can be evaluated. For devices with gold wire it is a more valuable screen as it can detect damage done to wires during centrifuge and other such tests, as well as most assembly defects. See MIL-STD-883, Method 2012.

Y

Y axis

The vertical direction, perpendicular to the X axis, in a two-dimensional system of coordinates. Y- Y signifies one direction followed in a step-and-repeat method.

"Y" motion

Registration adjustment front to rear of the screen pattern to the substrate, in screen printing.

Yield

The ratio of usable components at the end of a manufacturing process to the number of components initially submitted for processing. Can be applied to any input-output stage in processing, and so must be carefully defined and understood. Usually measured in percentage (%) i.e. 1000 units in, 900 units out, yield = 90% .

Z

Zener diode

A P-N junction two-terminal, single junction semi-conductor device reverse biased into the breakdown region and providing high impedance under less than breakdown voltage but conduction with no impedance above breakdown voltage level.

"Z" motion.

Vertical adjustment of screen substrate distance. Used for setting snap-off and leveling in screen printing.

Zymurgy

The chemistry of fermentation, particularly as it relates to brewing and wine-making. Included here because it is the last word in almost any encyclopedia.