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NEIL SCLATER • JOHN MARKUS

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SIXTH EDITION

NEIL SCLATER

JOHN MARKUS

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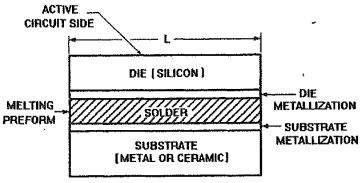


Die bonding process of a silicon die to a substrate, shown schematically.

silicones, and epoxies). The most common technique for bonding a silicon chip or die to a ceramic package or metal can is with a gold-silicon (Au-Si) bond at about 425°C. The silicon diffuses into the gold until the Au-Si eutectic composition is reached. Bonding with soft solder (95% lead, 5% tin) is a lower-temperature (about 300°C) alternative.

dielectric Another term for an insulator or material that has poor electric conductivity. Dielectrics such as air, mica, paper, plastic film, or ceramic separate the metal foil or metallized plates in a capacitor to isolate them electrically and store electric energy. In semiconductor fabrication, dielectric materials such as silicon dioxide provide electrical isolation between adjacent active devices, and metallized interconnects as well as between the gate and channel of MOSFETs.

dielectric absorption The persistence of electric polarization in certain dielectrics after removal of the electric field. The effect can last for several years in certain mixtures of wax that are allowed to harden in a strong electric field. Electrets are based on this effect.

dielectric constant The property of a material that determines how much electrostatic energy can be stored per unit volume when unit voltage is applied. In effect, it is the ratio of the capacitance of a capacitor filled with a given dielectric to that of the same capacitor having only a vacuum as dielectric. Also called permittivity.

dielectric current The current flowing at any instant through a surface of a dielectric that is located in a changing electric field.

dielectric diode A capacitor in which the negative electrode can emit electrons into the normally insulating region between the plates. The charge stored on the capacitor is thus continuously in transit between the electrodes, to give current flow in one direction. Cadmium sulfide crystals can serve as the dielectric.

dielectric dispersion The phenomenon in which the dielectric constant of an insulating material varies with frequency.

dielectric dissipation factor The cotangent of the dielectric phase angle of a dielectric material.

dielectric fatigue The decrease in the ability of some dielectrics to withstand breakdown following long exposure to voltage.

dielectric gas A gas that has a high dielectric constant, such as sulfur hexafluoride. It acts as an insulator in laser cavities and high-powered microwave equipment.

dielectric heating The heating of a nominally insulating material by placing it in a high-frequency electric field. The heat results from internal losses during the rapid reversal of polarization of molecules in the dielectric material.

dielectric hysteresis A lagging of the electric field in a dielectric with respect to the alternating voltage applied to the dielectric. This effect causes a dielectric hysteresis loss comparable to that produced by magnetic hysteresis in a ferrous material.

dielectric insulator layer A layer of nonconducting material laid down between layers of metallization to prevent electrical short-circuiting between them.

dielectric isolation [DI] The electrical isolation of active components in an integrated circuit from each other by an insulator (dielectric material). The active devices are formed in "tubs" of silicon dioxide (glass) dielectric material rather than by reverse-biased PN junctions.

dielectric lens A lens made of dielectric material so that it refracts radio waves in the same manner that an optical lens refracts light waves. Microwave antennas can be equipped with these lenses.

dielectric-lens antenna An aperture antenna whose beam width is determined by the dimensions of a dielectric lens through which the beam passes.

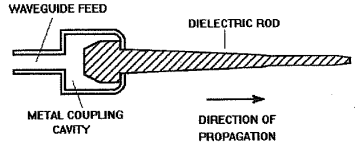
dielectric loss The electric energy that is converted into heat in a dielectric subjected to a varying electric field.

dielectric matching plate A dielectric plate used as an impedance-matching transformer in a waveguide.

dielectric phase angle The angular difference in phase between the sinusoidal alternating voltage applied to a dielectric and the resulting alternating current.

dielectric power factor The cosine of the dielectric phase angle.

dielectric-rod antenna A surface-wave antenna whose end-fire radiation pattern is produced by the propagation of a wave from a cavity down the length of a tapered dielectric rod. If the rod diameter is less than a half wavelength, the wave continues beyond the end of the rod into free space. If the rod is made of polystyrene, it is called a *polyrod;* if it is made of a *ferrite* material, it is called a *ferrod.* The higher the dielectric constant, the thinner the rod can be.



Dielectric rod antenna made from a tapered dielectric rod with a diameter less than a half wavelength propagates the wave in the direction of the rod

dielectric strength The maximum potential gradient a material can withstand without rupture. Usually specified in volts per millimeter of thickness. Also called electric strength.

dielectric test A destructive test on a device, circuit, or product in which a voltage higher than the rated value is applied for a specified time. The objective is to determine the failure voltage of insulating materials to verify their selection for the manufacture of components and products and to determine their *margin of safety.*

dielectric waveguide A waveguide consisting of a dielectric material surrounded by air. Electromagnetic

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tion circuits, and are applied to the control grid of the picture tube.

retrace interval The interval of time for the return of the blanked scanning beam of a television picture tube or camera tube to the starting point of a line or field. It is about 7 μs for horizontal retrace and 500 to 750 μs for vertical retrace in NTSC TV broadcasting. It is also called retrace period, retrace time, return interval, return period, or return time.

retrace line The line traced by the electron beam in a cathode-ray tube in going from the end of one line or field to the start of the next line or field. It is also called *return line.*

retrace period *Retrace interval.*

retrace time *Retrace interval.*

retransmission unit A control unit that is an intermediate station for feeding one radio receiver-transmitter unit automatically to another receiver-transmitter unit for two-way communication.

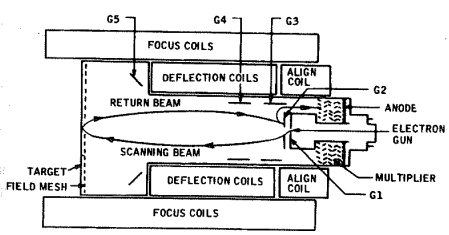
retroaction British term for *positive feedback.*

retroreflector A device that reflects radiation back on a path parallel to the incident rays over a wide range of retroreflector orientation as in laser surveying. One version, the corner reflector, is an efficient radar target.

return *Echo.*

return-beam mode A camera-tube operating mode in which the output current is derived from that portion of the scanning beam not accepted by the target.

return-beam vidicon A vidicon whose electron beam that scans the target is bent back from the target to an electron multiplier and anode which surround the electron gun. Light falling on the target surface changes the resistance of the surface, and thereby modulates the energy in the return beam.



Return-beam vidicon construction.

return interval *Retrace interval.*

return line *Retrace line.*

return loss 1. The difference between the power incident upon a discontinuity in a transmission system and the power reflected from the discontinuity. 2. The ratio in decibels of the power incident upon a discontinuity to the power reflected from the discontinuity.

return period *Retrace interval.*

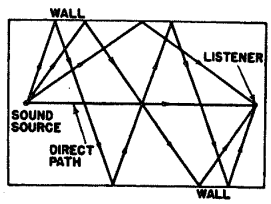
return time *Retrace interval.*

return to bias Magnetization of magnetic tape to saturation in a direction called minus, representing binary 0. Binary 1 signals are recorded by magnetizing the tape in the opposite direction. After each binary 1 pulse the tape returns to the minus (bias) condition. This method requires a clock to read 0s.

return-to-zero code [RZ code] A communications code in which a binary 0 is represented by one bit time at the 0 level, and a binary 1 is pulsed so that it reaches the 1 level for only half a bit time. The signal therefore returns to 0 (or stays at 0) after each bit. With this code, only half as much data can be stored in a given area or distance as with nonreturn-to-zero code.

return wire The ground wire, common wire, or negative wire of a DC power circuit.

reverberation The persistence of sound at a given point after direct reception from the source has stopped. In air it can be caused by repeated reflections from a small number of boundaries or free decay of normal modes of vibration that were excited by the sound source. In water it can be caused by scattering from a large number of inhomogeneities in the medium or reflections from bounding surfaces.



Reverberation paths for sound waves in a room.

reverberation absorption coefficient The term for the sound absorption coefficient when the distribution of incident sound is completely random.

reverberation chamber An enclosure that has had all surfaces made as sound-reflective as possible. Acoustic measurements are made in this kind of room. It is also called a reverberation room.

reverberation-controlled gain circuit [RCG circuit] A circuit for underwater sound equipment that varies the gain of the receiving amplifier in proportion to the strength of undesired reverberations associated with the desired echo.

reverberation reflection coefficient The term for the sound reflection coefficient when the distribution of incident sound is completely random.

reverberation room *Reverberation chamber.*

reverberation time The time in seconds required for the average sound-energy density at a given frequency to reduce to one-millionth of its initial steady-state value after the sound source has been stopped. This corresponds to a decrease of 60 dB.

reverberation-time meter An instrument that measures the reverberation time of an enclosure.

reverberation transmission coefficient The term for the sound transmission coefficient when the distribution of incident sound is completely random.

reverberation unit A circuit that generates reverberation synthetically in a sound system. In one version, audio signal energy is converted into torsional motion of coil springs by a magnetic driver. A magnetic pickup at the other end of the springs converts the motions back into audio signals after a time delay, to give the effect of listening in a reverberant hall.

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