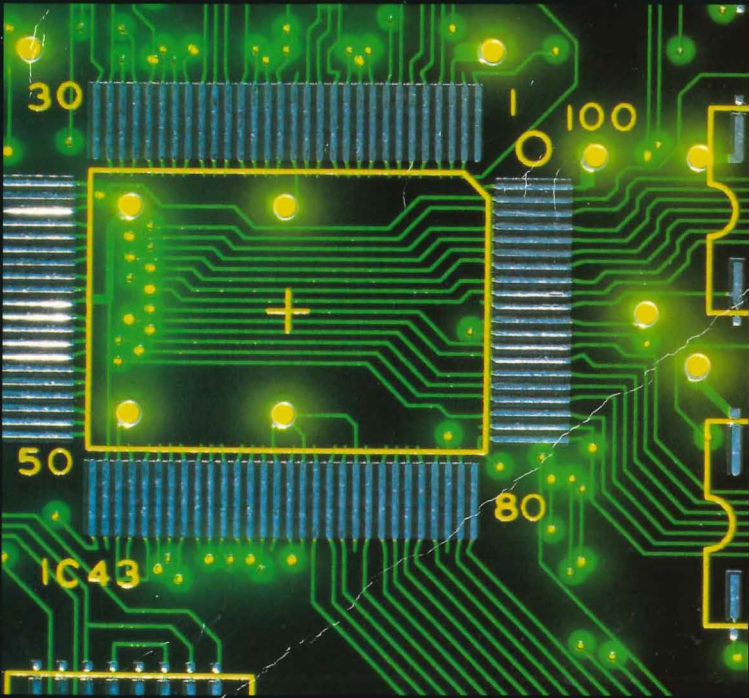


PENGUIN

DICTIONARY OF
ELECTRONICS

EDITED BY VALERIE ILLINGWORTH



NEW EDITION



PENGUIN
REFERENCE

The Penguin Dictionary of
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PENGUIN BOOKS

plitudes; the frequency (the *beat frequency*) is equal to the difference between the original frequencies. The production of beats is termed *beating* and is achieved, for example, by using a *beat-frequency oscillator*. This device incorporates two radio-frequency oscillators, one producing a fixed frequency wave and the other a variable frequency; the output is produced by beating together the two frequencies.

Beating is also the basis on which a musical instrument is tuned by reducing the beats with a reference to 0 Hz by adjusting, for example, the string or pipe length.

bel Symbol: B. ▶decibel.

beryllium oxide *Syn.* beryllia. Symbol: BeO. An insulating material that has a high thermal conductivity (about half that of copper) and is used in heat sinks.

Bessel filter A type of electrical ▶filter based on a mathematical power series known as the Bessel polynomial. The filter is ▶maximally flat in the pass-band and it also has ▶linear phase response and consequently a Gaussian delay response. The ▶amplitude response approximates a Gaussian response.

beta circuit ▶feedback.

beta current gain factor *Syn.* common-emitter forward-current transfer ratio; forward-current gain. Symbol: β . The short-circuit current-amplification factor in a bipolar transistor with ▶common-emitter connection:

$$\beta = (\partial I_C / \partial I_B) \quad V_{CE} \text{ constant}$$

where I_C is the collector current and I_B is the base current; the collector voltage, V_{CE} , is constant. β is always greater than unity and practical values up to 500 are used.

beta cut-off frequency The frequency at which the ▶beta current gain factor has fallen to $1/\sqrt{2}$ of its low frequency value. The beta cut-off frequency is considerably lower than the ▶alpha cut-off frequency.

BFSK *Abbrev. for* binary frequency shift keying. ▶frequency modulation.

bias *Short for* bias voltage. A voltage applied to an electronic device to ensure that it operates on a particular portion of its ▶characteristic curve.

biased automatic gain control *Syn.* delayed automatic gain control. ▶automatic gain control.

bias voltage ▶bias.

BiCMOS *Syn.* merged CMOS/bipolar. Integrated circuits that contain both ▶bipolar junction transistors and ▶complementary MOS transistors (CMOS). The combination of both types of device on the same chip has a wide variety of functions and allows the advantages of both processes to be exploited. Bipolar circuits are inherently faster than CMOS circuits and have much better analogue performance. Bipolar transistors are preferred for ▶operational amplifiers, ▶comparators, ▶multipliers, and high-speed logic circuits, such as ▶emitter-coupled logic (ECL). CMOS circuits are preferred where low power dissipation and high ▶packing densities are required, as with memory counters,

diametrical voltage \triangleright voltage between lines.

diamond-like carbon A thin-film form of carbon that has a crystal structure of diamond, though it may contain significant crystalline defects and carbon-based impurities. It is produced by \triangleright chemical vapour deposition. This material has a very wide \triangleright energy band gap, and behaves like a \triangleright semiconductor. It is being developed for flat-panel display technologies and high-speed microelectronics.

diaphragm 1. A vibrating membrane used in sound \triangleright transducers such as microphones and loudspeakers. **2.** A porous partition in an electrolytic cell that separates the electrolytes while allowing ions to pass through.

diaphragm relay \triangleright relay.

dibit A pair of binary bits transmitted across a channel simultaneously.

dichroic mirror A mirror designed to reflect one designated optical frequency band and transmit all others. It is used in colour TV cameras and for mixers and modulators in optical communication systems.

Dicke's radiometer An instrument that measures microwave noise power precisely by comparing it with the noise from a standard source in a waveguide.

die \triangleright chip.

dielectric A solid, liquid, or gaseous material that can sustain an electric field and act as an insulator. A *perfect dielectric* is one in which no energy is lost from an electric field applied across the dielectric. An *imperfect dielectric* is one in which \triangleright electric hysteresis losses occur. The displacement, D , lags behind the applied field, E , resulting in a typical hysteresis curve (\triangleright magnetic hysteresis) and in energy losses from the applied field, which appear in the form of heat.

dielectric constant *Syn.* relative permittivity. Symbol: ϵ_r . A dimensionless property of a material or medium equal to the ratio of the permittivity of the material or medium to the permittivity of free space. \triangleright permittivity.

dielectric heating A method of heating an insulating material, such as a plastic, in which a high-frequency alternating electric field is applied to the material. The periodic alternation of the electric field causes an alternating \triangleright dielectric polarization of the specimen, which results in the heating effect. Dielectric heating is usually effected by placing the specimen between specially shaped metal *applicators*, which form the electrodes of a capacitor, and applying the alternating field across them. A single applicator is sometimes used, applied to one surface of the specimen, when local heating only is required. The *heating depth* is the depth below the surface at which the heating effect due to the single applicator is observed. \blacktriangleright induction heating.

dielectric isolation A method of isolating individual regions in an integrated circuit, particularly a \triangleright bipolar integrated circuit, by surrounding the region with insulating material (dielectric) rather than with isolating \triangleright diffused junctions. There are many different methods used to achieve dielectric isolation.

either the same type – *isotype heterojunction* – or as a \triangleright p-n junction – *anisotype heterojunction*. \triangleright heterojunction bipolar transistor; high electron mobility transistor.

heterojunction bipolar transistor (HBT) A \triangleright bipolar junction transistor that incorporates a wide band gap emitter. The emitter-base junction is a \triangleright heterojunction between semiconductors of different energy band gap. The following are typical material systems:

AlGaAs(emitter)/GaAs(base);
 AlInAs/InGaAs;
 Si/SiGe

The wider band gap of the emitter reduces significantly the injection of majority carriers from base to emitter, thus maximizing the desired injection of carriers from emitter to base. This eliminates the requirement for a heavily doped emitter to achieve the same result, and consequently allows the base doping to be increased. An increase in base doping is desirable from a device viewpoint as the base resistance can be reduced significantly. This leads to an improvement in the high-frequency performance of the transistor. HBTs are used at radio- and microwave frequencies, in integrated circuit and power applications, and in optoelectronic ICs.

heterojunction FET \triangleright high electron mobility transistor.

heterojunction photodiode \triangleright photodiode.

heterostructure laser \triangleright semiconductor laser.

Heusler alloys Alloys that exhibit ferromagnetic properties although they contain no ferromagnetic material. They contain manganese, aluminium, and zinc or copper.

hex *Short for hexadecimal.*

hexadecimal A number system with 16 elements present, i.e. base 16. These elements are the numbers 0 to 9 and the letters A to F. Therefore $10_{10} = A_{16}$, $11_{10} = B_{16}$, etc., where the subscript indicates the decimal or hexadecimal system. Hexadecimal is often used in computer systems, for example for 16-bit arithmetic.

hexagon voltage *Syn. mesh voltage.* \triangleright voltage between lines.

HF *Abbrev. for high frequency.* \triangleright frequency band.

hidden Markov model (HMM) A statistical model used for automatic pattern matching after a training period when the model is presented with a large number of examples of the patterns to be recognized.

hi-fi Acronym from *high fidelity*. \triangleright reproduction of sound.

high-density packaging The packaging of a given set of electrical components in a very small volume through the application of miniaturization techniques, as by the use of \triangleright integrated circuits or \triangleright surface-mount components.

PENGUIN REFERENCE

The field of electronics is rapidly expanding, particularly in the areas of computing, communications and sound recording. To keep abreast of these developments, *The Penguin Dictionary of Electronics* has been fully revised and extended with over 1,000 new entries. It offers:

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The front cover shows a computer-graphics image of a circuit board © Ken Biggs/Science Photo Library



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