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# ELECTRICAL ENGINEERING

## DICTIONARY

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**donor** an impurity in a semiconductor that donates a free electron to the conduction band.

**door** See [lid](#).

**dopant** an impurity substance (such as phosphorus or boron) added in very small controlled quantities to a semiconductor base material (such as silicon or gallium arsenide), thereby changing the material conduction characteristics by modifying electron and/or hole concentration. A donor dopant is one that gives rise to electrons and an acceptor dopant is one that gives rise to holes.

**doping** the process of introducing impurity atoms into pure silicon to change its electrical properties. The impurities may be either n-type (introducing an additional conducting electron) or p-type (introducing the absence of a conducting electron, also called a “hole”).

**Doppler broadened lineshape function** spectral function that results from Doppler shifts caused by the velocity distribution of atoms or molecules in a gas; a Gaussian function for a Maxwellian velocity distribution.

**Doppler broadening** broadening of a spectral line due to Doppler shifts caused by the random motion of atoms or molecules in a vapor.

**Doppler effect** See [Doppler shift](#).

**Doppler filter** a filter used to resolve targets from each other and from extraneous returns from other objects (called clutter) by filtering in the velocity or Doppler domain. So-called because the Doppler effect causes frequency shifts proportional to velocity variations in tracked objects.

**Doppler frequency** a shift in frequency of the returned power from a target as a result of the target’s motion relative to the illuminating source.

**Doppler linewidth** characteristic width of a Doppler-broadened spectral line; usually the full width at half maximum when the line is Gaussian.

**Doppler power spectrum** a function characterizing the spread of average received power as a function of Doppler shift. Can be obtained from the scattering function by integrating over the delay variable. See also [scattering function](#), [multipath propagation](#).

**Doppler radar** radar-based technique used in measuring the velocity of a moving target or wind by measuring the Doppler shift (Doppler effect).

**Doppler shift** a frequency shift in a received signal caused by time-variant transmission delay, or equivalently time-variant propagation path length. This in turn is caused by movement of terminals with respect to each other, or by movement of reflecting objects. In optics, frequency shifts imposed on laser beams such as when used in laser radar or when diffracted by an acoustic wave.

The Doppler shift depends on the frequency of the signal and the angle of arrival of the signal relative to the direction of movement of the receiver. For a signal consisting of a range of frequencies, each frequency component will experience a different shift. Hence the received signal will have a different bandwidth than the transmitted signal (Doppler dispersion).

For a tone (continuous-wave) signal of frequency  $f$ , the Doppler shift  $f_D$  observed on a single propagation path of changing length is given by

$$f_D = \frac{fv}{c},$$

where  $v$  is the rate (in m/s) of path length change, and  $c$  is the speed of light.

Also known as Doppler effect.

**Doppler spread** the increase of bandwidth of a signal due to doppler shifting of

**field-effect transistor (FET)** a majority-carrier device that behaves like a bipolar transistor with the important difference that the gate has a very high input impedance and therefore draws no current.

An active device with three terminals — gate, source, and drain — in the active (amplifier) mode of operation, the drain current is related to the gate-source voltage. The relationship is usually approximated by a square law, but there are significant deviations from the square law depending on factors such as device geometry. The FET can also be used as a switch, with the gate-source voltage controlling the “on/off” state of the conducting channel between source and drain terminals. The input resistance at the gate is extremely high (usually of order tens of megaohms) and the gate current is negligibly small (usually of order picoamperes or less).

There are various families of FETs, including MOSFETs and JFETs. Within each family, there are two types of FET, n-channel and p-channel (named for the sign of the majority carriers that form the current conducting path between source and drain).

Some FETs also have a fourth terminal, the “substrate” or “body” terminal. The p-n junctions between the substrate and the drain and source terminals should be reverse-biased to insure proper device operation.

**field-oriented control** speed control of an induction motor obtained by varying the magnitude and orientation of the airgap magnetic field. This is also referred to as vector control and requires sensing of the rotor position. Vector controllers allow the induction motor to operate very much like a DC motor, including development of rated torque at zero speed.

**field-programmable gate array (FPGA)**

(1) a programmable logic device that consists of a matrix of programmable cells embedded in a programmable routing mesh. The combined programming of the cell functions and routing network define the function of the device.

(2) a gate array with a programmable multi-level logic network. Reprogrammability of FPGAs make them generic hardware and allow them to be reprogrammed to serve many different applications. FPGAs consist of SRAMS, gates, latches, and programmable interconnects.

**FIFO** See [first-in-first-out](#).

**FIFO memory** commonly known as a queue. It is a structure where objects are taken out of the structure in the order they were put in. Compare this with a LIFO memory or stack. A FIFO is useful for buffering data in an asynchronous transmission where the sender and receiver are not synchronized: the sender places data objects in the FIFO memory, while the receiver collects the objects from it.

**figure of merit** performance evaluation measure for the various target and equipment parameters of a sonar system. It is a subset of the broader sonar performance given by the sonar equations, which includes reverberation effects.

**file format** the structure of the computer file in which an image is stored. Often the format consists of a fixed-size header followed by the pixel values written from the top to the bottom row and within a row from the left to the right column. However, it is also common to compress the image. See also [Graphics Interchange Format](#), [header](#), [image compression](#), [tagged image file format \(TIFF\)](#).

**Filippov method** a definition of a solution to a system of first-order differential equations with discontinuous right-hand side,

$$\dot{\mathbf{x}} = \mathbf{f}(t, \mathbf{x}),$$

proposed by A. F. Filippov. A vector function  $\mathbf{x}(t)$  defined on the interval  $[t_1, t_2]$  is a solution to the above system of differential equations in the sense of Filippov, if it is absolutely continuous and for almost all

(VCO) free-running frequency over which the VCO will, once locked, remain synchronized with the signal frequency. Lock range is sometimes called tracking bandwidth.

**lock-in amplifier** a system for detecting weak, noisy periodic signals based on Synchronous detection, and incorporating all the other components necessary for recording the amplitude profile of the weak incoming signal, including input AC amplifier, diode or other detectors, low-pass filter, DC amplifier, and any special filters. Such instruments are nowadays constructed with increasing amounts of digital and computerized circuitry, depending on the frequency of operation.

**lock-out** phenomenon exhibited during channel switching that results from a fast automatic gain control (AGC) system interacting with the horizontal automatic frequency control (AFC), thereby reducing the pull-in range of the AFC system.

**lock-up-free cache** See [nonblocking cache](#).

**locked-rotor current** the current drawn by an induction motor when the shaft is not moving and rated voltage is applied. The starting current is essentially equal to the locked rotor current and may be as much as eight times the rated current of the machine.

**locked-rotor torque** the torque produced in an induction motor when the rotor is locked and rated AC voltage is applied to the stator.

**locking** See [bus locking](#).

**lockout** the condition following fault clearing when the circuit will not attempt a reclose. Transformers, generators, and buses typically trip once and lockout immediately. Transmission lines and distribution lines will generally attempt one or more recloses, and will lockout if the fault remains following the last reclose in the sequence.

**lockout relay** an auxiliary relay which is operated by protective relay(s) that in turn opens the appropriate circuit breakers or other fault clearing devices. The lockout relay will remain in the trip position until manually reset, and is used in protective zones where temporary faults are unusual and the potential for equipment damage is high.

**LOCOS** See [local oxidation of silicon](#).

**log periodic antenna** broadband antenna designed using physical dimensions (lengths, spacings, diameters, etc.) that vary logarithmically. The result of such designs is an antenna whose performance parameters (e.g., input impedance) is periodic with respect to the logarithm of the frequency.

**log-likelihood function** the likelihood function of  $y$  given  $x$  is the conditional PDF,  $p(y|x)$ . The log-likelihood function is the logarithm of the likelihood function,  $\log(p(y|x))$ .

**log-normal distribution** probability distribution with density

$$f(x) = 1/(\sqrt{(2\pi)}\sigma x)e^{-((\log x - \mu)^2)/(2\sigma^2)}$$

where  $\mu$  and  $\sigma$  are the mean and standard deviation of the logarithm.

**logarithmic quantization** a method for non-linear scalar quantization where the input signal is transformed logarithmically and then coded using uniform quantization. The transformation is utilized to enhance performance for sources having nonuniform probability distribution, and to give robustness towards varying input signal dynamics.

**logic analyser** a machine that can be used to send signals to, and read output signals from, individual chips or circuit boards.

**logic circuit** a circuit that implements a logical function, such as AND, OR, NAND, NOR, NOT, or XOR. (DB)

**router** a node, connected to multiple networks, that forwards packets from one network to another. It is much more complex than bridges that work between networks having compatible protocols. Also called a gateway.

**routing** given a collection of cells placed on a chip, the routing routine connects the terminals of these cells for a specific design requirement.

**row decoder** logic used in a direct-access memory (ROM or RAM) to select one of a number of rows from a given row address. *See also* [two-dimensional memory organization](#).

**row-access strobe** *See* [two-dimensional memory organization](#).

**RS flip-flop** a single-bit storage element, usually formed by connecting two NOR or NAND gates in series. RS stands for reset-set. For state variable  $Q$  and next state variable  $Q'$ , the simplified truth table is given as

$R$	$S$	$Q$	$Q'$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	X
1	1	1	X

the symbol “X” is used to denote an unknown state for the flip-flop. *See also* [JK flip-flop](#).

**RS-170A** technical standard developed by the Electronics Industry Association that describes in detail the relationship between vertical, horizontal, and subcarrier components within a video signal. The standard permits synchronization of two or more video signals.

**RS-422** technical standard developed by the Electronics Industry Association that defines the exact physical, electrical, and func-

tional characteristics for a 40-pin connector that links a computer to communication equipment.

**RSGNN** *See* [recursive self-generating neural network](#).

**RSSI** *See* [received signal strength indicator](#).

**RTB** reverse translation buffer. *See* [inverse translation buffer](#).

**RTU** *See* [remote terminal unit](#).

**rubbers** personal protective wear for line workers, including insulating gloves, sleeves, and rubber boots.

**ruby** amplifying medium employed in the first man-made optical frequency laser.

**ruby laser** first man-made optical frequency laser.

**run winding** the main winding of a single-phase induction motor.

**run-length coding** the assignment of a codeword to each possible run of 0s (white pel sequence) or run of 1s (black pel sequence) in a scan of the subject copy.

**run-length encoding** *See* [run-length limited code](#).

**run-length limited (RLL) code** a line code that restricts the minimum and/or maximum number of consecutive like-valued symbols that can appear in the encoded symbol sequence.

**running digital sum** the difference between cumulative totals of the number of logic 1s and number of logic 0s in a binary sequence. It is a common measure in the performance of a line code.

**running integral** for the function  $x(t)$ , the running integral,  $y(t)$  is  $y(t) = \int_{-\infty}^t x(\tau) d\tau$ .

**vertical polarization** a term used to identify the position of the electric field vector of a linearly polarized antenna or propagating EM wave relative to a local reference, usually the ground or horizon. A vertically polarized EM wave is one with its electric field vector aligned perpendicular to the local horizontal.

**vertical roll** in television, the apparent continuous upward or downward movement of the picture, resulting from the lack of synchronization between the transmitter and receiver.

**vertical sync pulse** a signal interval of the NTSC composite video signal provided for the synchronization of the vertical deflection system; the vertical sync interval has a duration of three horizontal lines and is serrated with six pulses. The vertical sync interval starts after six equalizing pulses (3 horizontal line periods) that identify the beginning of the vertical blanking interval. The vertical serration preserves the horizontal line synchronization information during the vertical sync pulse interval with the one-half horizontal line time-signal transition from the composite video blanking signal level to the sync signal level. The serrated vertical pulse duration is at the blanking level for  $7 \pm 1\%$  of the horizontal line time.

**vertically integrated utility** a utility in which generation, transmission, and distribution divisions are all owned by a single entity.

**very high-speed digital subscriber line (VDSL)** a digital subscriber line (DSL) that provides very high rates (13 Mbps, 26 Mbps, and 52 Mbps) through short subscriber loops (1 to 3 kft). A VDSL may support asymmetric rates between the customer premise and the central office.

**very-large-scale-integration (VLSI)** (1) a technology that allows the construction and interconnection of large numbers (millions) of transistors on a single integrated circuit.

(2) an integrated circuit made of tens of thousands to hundreds of thousands of transistors.

**very long instruction word (VLIW)** a computer architecture that performs no dynamic analysis on the instruction stream and executes operations precisely as ordered in the instruction stream.

**very small aperture terminal (VSAT)** a small earth station suitable for installation at a customer's premises. A VSAT typically consists of an antenna less than 2.4 m, an outdoor unit to receive and transmit signals, and an indoor unit containing the satellite and terrestrial interface units.

**vestigial sideband** (1) a portion of one sideband in an amplitude modulated signal, remaining after passage through a selective filter.

(2) Amplitude modulated signal in which one sideband has been partially or largely suppressed.

(3) The small amount of energy emitted in the unused sideband in a single-sided transmitter.

**VGA** See [video graphics adapter](#).

**VHF** very high frequency. See VHF power.

**VHF power** in television, the band of frequencies ranging from 30MHz to 300MHz.

**VHSIC** acronym for very high speed integrated circuit.

**via** a hole in the insulator between two metal layers on a multilayer integrated circuit that is etched and filled with a conducting material so that the two metal layers are electrically connected. Via resistance is typically less than 10 ohms.

**via hole** hole chemically etched from the back of a MMIC wafer and filled with metal