SEVENTH EDITION

MODERN DICTIONARY of ELECTRONICS

RUDOLF F. GRAF

Newnes

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REVISED AND UPDATED

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Rudolf F. Graf is an author whose name is well-known to engineers, technicians, and hobbyists around the world. He graduated as an electronics engineer from Brooklyn Polytechnic Institute and did his graduate work New York University. Mr. Graf has been active in the electronics industry for more than fifty years in capacities ranging from design and consulting engineer, chief engineer, chief instructor at electronics and television schools, and consulting editor. He also held various sales and marketing positions. Mr. Graf is the author or co-author of more than 150 technical articles published by major magazines. He has written about 50 books on electricity and electronics, with more than 2 million copies in print, including the best-selling *Video Scrambling & Descrambling for Satellite & Cable TV, Second Edition* and the *Circuits* series of books, both published by Newnes. A number of his books have been translated into several European languages as well as Chinese, Japanese, and Russian.

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Boston Oxford Auckland Johannesburg Melbourne New Delhi

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gyrostabilized platform — *See* stable platform.

gyrotron — A microwave vacuum tube based on the interaction between an electron beam and microwave fields in which coupling is achieved by the cyclotron resonance condition. This type of coupling allows the beam and microwave circuit dimensions to be large compared with a wavelength. Thus, the power density problems encountered in conventional traveling-wave tubes and klystrons at millimeter wavelengths are avoided in the gyrotron.

G-Y signal — In color television, the green-minus-luminance signal, representing primary green minus the luminance, or Y, signal. It is combined with a luminance, or Y, signal outside or inside the picture tube to yield a primary green signal.

H

H — 1. A radar air-navigation system using an airborne interrogator to measure the distance from two ground responder beacons. *See also* shoran. 2. Symbol for heater, magnetic field strength, or henry.

hacker — 1. A person with computer expertise intrinsically interested in the exploration of computer systems and their capabilities. 2. A person who accesses computer systems without authorization. 3. One who deliberately tries to penetrate the security of other computers. 4. A skilled computer enthusiast who is obsessed with learning about programming and exploring the capabilities of computer systems. 5. A person who gains unauthorized access to a computer system.

hacking — Using a microcomputer system or terminal to bypass the security of a large computer system.

hairpin pickup coil — A hairpin-shaped, single-turn coil for transferring UHF energy.

hairpin tuning bar — A sliding hairpin-shaped metal bar inserted between the two halves of a doublet antenna to vary its electrical length.

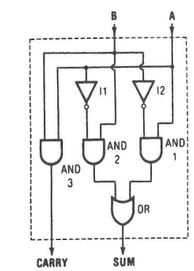
halation — 1. Distortion seen as blurred images and caused by reflection of the image rays off the back of a fluorescent screen that is too thick. 2. The spreading of light in a photographic emulsion outside the intended area of exposure by reflection from the rear surface of the material supporting the emulsion; this is distinguished from the diffusion that takes place within the emulsion layer. 3. A glow or diffusion that surrounds a bright spot on a television picture tube screen. A defect in picture tube quality is indicated. 4. In a cathode-ray tube, the glow surrounding a bright spot that appears on the fluorescent screen as the result of the screen's light being reflected back by the front and rear surfaces of the tube's face.

half-add — In a computer, an operation that is performed first in carrying out a two-step binary addition. It consists of addition of corresponding bits in two binary numbers, with any carry information being ignored. *See also* exclusive OR.

half adder — 1. A circuit that will accept two binary input signals and produce corresponding sum and carry outputs. So called because, above the first order, two half adders per order are required when adding two quantities. 2. Building-block circuit used in digital computers. A combination of logic gates adds two bits and delivers an answer — two bits called sum and carry. Half adders can be combined to add numbers of any length. Two half adders make up a full adder. 3. A logic element that adds two input bits, but does not have provision for adding the carry from a previous addition. *See also* full adder.

half cell — An electrode, submerged in an electrolyte, for measuring single electrode potentials.

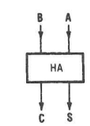
half cycle — The time interval required for the operating frequency to complete one-half, or 180°, of its cycle.



Circuit.

B	A	CARRY	SUM
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Truth table.



Symbol.

Half adder.

half-digit — In digital meters provided with 100 percent overranging, an additional most-significant digit provided at the left of the readout, capable of displaying the numeral 1 when the measurement exceeds the full-scale range.

half duplex — 1. A communication system in which information can be transmitted in either direction, but only in one direction at a time. 2. In communications, pertaining to an alternate independent transmission made in one direction at a time. 3. A mode of data transmission capable of communicating in one of two directions, but in only one direction at a time. 4. Refers to a communication channel that can receive and transmit, but not simultaneously.

half-duplex circuit — Abbreviated HDX. A circuit that permits one-direction electrical communications between stations. Technical arrangements may permit operation in either direction, but not simultaneously. Therefore, this term is qualified by one of the following suffixes: s/o for send only, r/o for receive only, or s/r for send or receive.

half-duplex modem — A modem with a single wire pair that can transmit in both directions but not simultaneously.

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line frequency — Also called horizontal line frequency or horizontal frequency. 1. In television, the number of times per second the scanning spot crosses a fixed vertical line in the picture in one direction, including vertical-return intervals. 2. The nominal operating frequency of the power-line voltage used to supply operating power to instruments or equipment.

line-frequency regulation — The change in output (current voltage or power) of a regulated power supply for a specified change in line frequency.

line group — The frequency spectrum occupied by a group of carrier channels as they are applied to a transmission facility.

line hit — An electrical interference causing the introduction of spurious signals on a circuit.

line hydrophone — A directional hydrophone consisting of a single straight-line element, an array of adjacent electroacoustic transducing elements in a straight line, or the acoustic equivalent of such an array.

line impedance — The impedance measured across the terminals of a transmission line.

line input — Input channel of an amplifier designed to accept signal at a given level from a line at a specific impedance, usually 600 ohms.

line interlace — *See* interlaced scanning.

line leakage — Resistance existing through the insulation between the two wires of a telephone-line loop.

line lengthener — A device for altering the electrical length of a waveguide or transmission line, but not its physical length or other electrical characteristics.

line level — 1. The level of a signal at a certain point on a transmission line. Usually expressed in decibels. 2. Based roughly on the "standardized" signal intensity sent over a telephone line, this term refers to any audio signal having a maximum intensity of between $\frac{1}{2}$ and $1\frac{1}{2}$ volts. Typically, this is the signal level put out by audio components that do not require preamplification (tuners, for instance).

line load — Usually a percentage of maximum circuit capability to reflect actual use during a period of time (e.g., peak-hour line load).

line loop — An operation performed over a communication line from an input unit at one terminal to output units at a remote terminal.

line loop resistance — Also called loop resistance. The metallic resistance of the pair of line wires that extend from a subscriber's telephone to the central office (does not include the resistance of the telephone).

line loss — The total of the various energy losses in a transmission line.

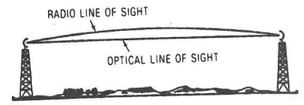
line microphone — A directional microphone consisting of a single straight-line element, an array of adjacent electroacoustic transducing elements in a straight line, or the acoustical equivalent of such an array.

line noise — Noise originating in a transmission line.

line of force — 1. Used in the description of an electric or magnetic field to represent the force starting from a positive charge and ending on a negative charge. 2. In an electric or magnetic field, an imaginary line in the same direction as the field intensity at each point. Sometimes called a maxwell when used as a unit of magnetic flux.

line of propagation — The path over which a radio wave travels through space.

line of sight — 1. The distance to the horizon from an elevated point, including the effects of atmospheric refraction. The line-of-sight distance for an antenna at zero height is zero. 2. A straight line between an observer or radar antenna and a target. 3. An unobstructed, or optical, path between two points. 4. The radio-propagation characteristic of a microwave. 5. The optical axis of a telescope or other observation system. The straight line connecting the object and the objective lens of the viewing device.



Line of sight, 3.

line-of-sight coverage — The maximum distance for transmission above the highest usable frequency. Radio waves at those frequencies do not follow the curvature of the earth and are not reflected from the ionosphere, but go off into space and are lost.

line-of-sight stabilization — In shipboard or airborne radar, compensating for the roll and pitch by automatically changing the elevation of the antenna in order to keep the beam pointed at the horizon.

line of travel — The path followed by an electromagnetic wave from one point to another

line oscillator — An oscillator in which the resonant circuit is a section of transmission line an integral number of quarter wavelengths in electrical length.

line output — Output channel of an amplifier designed to deliver signal at a given level to a line at a specific impedance, usually 600 ohms.

line pad — In radio broadcasting, a pad inserted between the final program amplifier and the transmitter to ensure a constant load on the amplifier.

line printer — 1. In computers, a high-speed printer that produces an entire line at one time. All characters of the alphabet are contained around the rim of a continuously rotated disc, and there are as many discs as there are characters in the line. The computer momentarily stops the discs at the right characters for each line, and stamps out an impression in a fraction of a second. 2. A high-speed printer capable of printing simultaneously a complete line (80 to 120 characters) at once. It is capable of printing as many as 3000 lines a minute.

line protocol — 1. A set of rules used to organize and control the flow of information between two or more stations connected by a common transmission facility. 2. A control program used to perform data-communication functions over network lines. Consists of both handshaking and line-control functions that move the data between transmit and receive locations.

line pulsing — A method of pulsing a transmitter by charging an artificial line over a relatively long period, and then discharging it through the transmitter tubes at a shorter interval determined by the line characteristics.

line radiator — A speaker enclosure that has several speakers arranged in a straight line to achieve a specific directional pattern.

line receiver — 1. A circuit to receive signals from a line, usually driven by a line driver and having features such as differential input, Schmitt trigger, and the like. 2. Used in conjunction with a line driver to detect signals at the receiving end of a long line. *See also* line driver.

line regulation — 1. The change in output (current, voltage, or power) of a regulated power supply for a specified change in line voltage. It may be stated as a percentage of the specified output and/or as an absolute value. 2. Percent change in output voltage at constant

junction temperature for a specified change in input voltage. This determines output accuracy of a regulator for changes in input voltage. 3. The maximum deviation of the output voltage of power supply in percent as the input voltage is varied from nominal to high line and nominal to low line. Output load and ambient temperature are held constant.

line relay — A relay activated by the signals on a line.

line sensor — A sensor with a detection zone that approximates a line or series of lines, such as a photoelectric sensor that senses a direct or reflected light beam.

line-sequential color-television system — A color-television system in which the individual lines of green, red, and blue are scanned in sequence rather than simultaneously.

line side — 1. The contacts or terminals of an electrical device, designed to be connected to a conductor carrying line voltage from the source; the input side. 2. The side of equipment that "looks" toward the transmission path.

lines of force — In electric and magnetic fields, the electric and magnetic forces of repulsion or attraction, which are taken to follow certain imaginary lines radiating from the electric charge or the magnetic pole. (It is assumed that any unit electric charge or unit magnetic pole placed in the appropriate field will be acted upon so as to move in the direction of these imaginary lines.)

line spectra — Spectra that originate from atoms; they are composed of lines having irregular spacing and intensity.

line spectrum — The spectrum of a periodic, discrete signal consisting of one or more frequencies. For example, a square wave is characterized by a fundamental and odd-order harmonics.

line speed — 1. The maximum rate at which signals may be sent over a given channel, usually expressed in bauds or in bits per second. 2. The rate at which text is transmitted over a line, expressed in bits per second.

line splitter — An active or passive device that divides a signal into two or more signals that contain all of the original information. A passive splitter feeds an attenuated version of the input signal to the output ports. An active splitter amplifies the input signal to overcome the splitter loss.

line-stabilized oscillator — An oscillator in which the frequency is controlled by using one section of a line as a sharply selective circuit.

line stretcher — 1. A section of rigid coaxial line with telescoping inner and outer conductors that permit the section to be conveniently lengthened or shortened. 2. *See* line amplifier, 2.

line supervision — A means of determining that a transmission line is functional. Electronic protection of an alarm line accomplished by sending a continuous or coded signal through the circuit. A change in the circuit characteristics, such as a change in impedance due to the circuit's having been tampered with, will be detected by a monitor. The monitor initiates an alarm if the change exceeds a predetermined amount.

line switcher — Direct-current power supply that directly converts the ac line voltage to a lower dc value using switching techniques. Line switchers are highly efficient, but require care to contain electrical noise.

line switching — Also called circuit switching. A communications switching system that completes a circuit from sender to receiver at the time of transmission, as opposed to message switching.

line transformer — A transformer inserted into a system for such purposes as isolation, impedance matching, or additional circuit derivation.

line triggering — Triggering from the power-line frequency.

line unit — An electric device used in sending, receiving, and controlling the impulses of a teletypewriter.

line voltage — 1. The voltage existing in a cable or circuit, such as at a wall outlet or other terminals of a power line system. The line voltage is usually between 115 and 120 volts, with 117 as an average, but may vary at times as much as 5 volts above or below the 115- and 120-volt limits. It is also the voltage existing in a cable or circuit. 2. The voltage supplied by an electrical power line or source, measured at the point of supply or sometimes at the point of utilization.

line-voltage regulator — A device that counteracts variations in the power-line voltage and delivers a constant voltage to the connected load.

line voltage transient protection — A device, or circuit, generally located on the line side of the control, that will divert or dissipate the energy contained in an abnormal line voltage spike. The purpose of this is to prevent possible control damage, especially to solid-state components, as a result of excessive voltage surges.

linguistic — Pertaining to language or its study, including its origin, structure, phonetics, etc.

linguistic variable — Common-language terms used to describe a fuzzy set, such as "hot," "slow," "very cold," or "medium."

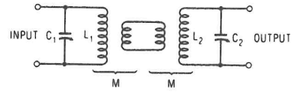
link — 1. A transmitter-receiver system connecting two locations. 2. In a digital computer, the part of a subprogram that connects it with the main program. 3. An interconnection. 4. In automatic switching, a path between two units of switching apparatus within a central office. *See* channel. 5. A communication channel between two adjacent signaling points that provides a path for messages to travel. 6. To connect two elements in a data structure by using index variables or pointer variables.

linkage — 1. A measure of the voltage that will be induced in a circuit by magnetic flux. It is equal to the flux times the number of turns linked by the flux. 2. A mechanical arrangement for transferring motion in a desired manner. It consists of solid pieces with movable joints. 3. In a computer, a technique used to provide interconnections for entry and exit of a closed subroutine to or from the main routine. 4. The instructions that connect one program to another, providing continuity of execution between the programs.

link blowing — An IC trimming technique that involves passing current pulses through points on the chip to open interconnection links between parallel resistors.

link circuit — A closed loop used for coupling purposes. It generally consists of two coils, each having a few turns of wire, connected by a twisted pair of wires or by other means, with each coil placed over, near, or in one of the two coils to be coupled.

link coupling — Inductive coupling between circuits. A coil in one circuit acts as the primary, and a coil in the second circuit as the secondary.



Link coupling.

linked list — A list formed by tying together (with pointers) several items on a disk.

shunting effect — A reduction in signal amplitude caused by the load that an amplifier or measuring instrument imposes on the signal source. For dc signals the shunting effect is directly proportional to the output impedance of the signal source and inversely proportional to the input impedance of the amplifier.

shunting or discharge switch — A switch that serves to open or to close a shunting circuit around any piece of apparatus (except a resistor), such as a machine field, a machine armature, a capacitor, or a reactor.

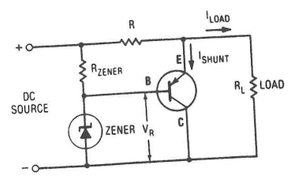
shunt leads — Those leads that connect the circuit of an instrument to an external shunt. The resistance of these leads must be taken into account when the instrument is adjusted.

shunt loading — Loading in which reactances are applied in parallel across the conductors of a transmission circuit.

shunt neutralization — *See* inductive neutralization.

shunt peaking network — *See* peaking network.

shunt regulator — A device placed across the output of a regulated power supply to control the current through a series-dropping resistance in order to maintain a constant output voltage or current.



Shunt regulator.

shunt T-junction — *See* H-plane T-junction.

shunt wire — A conductor joining two parts of an electric circuit to divert part of the current.

shunt-wound generator — A direct-current generator in which the field coils and armature are connected in parallel.

shunt-wound motor — 1. A direct-current motor that has its field (stationary member) and armature (rotating member) circuit connected in parallel. Its speed can be regulated by varying either the applied armature or field voltage. 2. A motor whose armature and field windings are connected in parallel. It has a fairly constant speed, but a low starting torque.

shutoff — A provision whereby a recorder will automatically go into the stop mode at the end of a tape. In some recorders, the automatic shutoff can be made to turn off the entire unit as well as any other components powered by it.

shutter — A movable cover that prevents light from reaching the film or other light-sensitive surface in a still, movie, or television camera except during the exposure time.

shuttle — A high-speed tape-running mode that permits fast cuing or rewinding of the tape.

sibilance — The strong emphasis in pronunciation of the letters "s" and "sh" in speech. It can be exaggerated by microphones having peaks in their high-frequency response.

SIC — Abbreviation for semiconductor integrated circuit.

side armature — An armature that rotates about an axis parallel to that of the core, with the pole face on a side surface of the core of a relay.

sideband attenuation — Attenuation in which the relative transmitted amplitude of one or more components of a modulated signal (excluding the carrier) is smaller than the amplitude produced by modulation.

sideband power — The power contained in the sidebands. This is the power to which a receiver responds when receiving a modulated wave, not the carrier power.

sidebands — 1. The frequency bands on both sides of the carrier frequency. The frequencies of the wave produced by modulation fall within these bands. 2. The wave components lying within such bands. During amplitude modulation with a sine-wave carrier, the upper sideband includes the sum (carrier plus modulating) frequencies, and the lower sideband includes the difference (carrier minus modulating) frequencies. 3. The modulation bands of frequencies that are both above and below the carrier frequency during modulation. 4. A band of frequencies on each side of the carrier frequency of an amplitude-modulated wave. Each sideband contains all of the information that was in the modulating wave. (The upper sideband contains frequencies that are the sums of the carrier and modulation frequencies, and the lower sideband contains the difference frequencies.)

sideband splatter — 1. Those portions of the modulation sidebands that lie beyond the limits of the assigned channel. 2. In radio communications, interference on other channels caused by spurious sidebands resulting from overmodulation.

side circuit — A circuit arrangement for deriving a phantom circuit. In four-wire circuits, the two wires associated with the "go" channel form one side circuit, and those associated with the return channel form another. *See also* phantom circuit.

side-circuit loading coil — A loading coil for introducing a desired amount of inductance into a side circuit while introducing a minimum amount of inductance into the associated phantom circuit.

side-circuit repeat coil — *See* side-circuit repeating coil.

side-circuit repeating coil — Also called side-circuit repeat coil. A device that functions as a transformer at a terminal of a side circuit, and acts simultaneously as a device for superposing one side of a phantom circuit on the side circuit.

side echo — An echo due to a side lobe of an antenna.

side frequency — One of the frequencies of a sideband.

side lobe — A portion of the beam from an antenna other than the main lobe. It is usually much smaller than the main lobe. *See* figure on page 691.

side-lobe blanking — A technique that compares relative signal strengths between an omnidirectional antenna and the radar antenna.

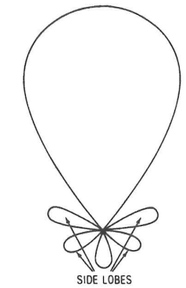
side-lobe cancellation — A technique designed to exclude or greatly attenuate jamming signals introduced through the side or back lobes of a receiving antenna.

side-looking airborne radar — A high-resolution airborne radar system in which the beam from the antenna is directed at right angles to the direction of flight.

siderial day — The time it takes for the earth to rotate exactly 360° about its axis with respect to the "fixed" stars. The siderial day contains 1436.07 minutes. *Compare* solar day.

sideswiper — A telegraph key that operates from side to side rather than up and down.

side thrust — 1. In disc recording, the radial component of force on a pickup arm caused by the stylus drag. 2. The tendency of a stylus to skate toward the center of



Side lobes.

record, causing increased wear on the inner groove wall. With low tracking weight, side thrust can cause the stylus to jump the record's groove.

sidetone — 1. The reproduction, in a telephone receiver, of sounds received by the transmitter of the same telephone set (e.g., hearing one's own voice in the receiver of a telephone set when speaking into the mouthpiece). 2. That portion of a speaker's voice that is fed back to his or her receiver.

sidetone telephone set — A telephone set with no balancing network for reducing sidetone.

siemens — 1. International standard unit of conductance that replaces and is identical with the term *mho*. The reciprocal of resistance in ohms. 2. The unit of electric conductance of a conductor in which a current of 1 ampere is produced by an electric potential difference of 1 volt.

sight check — To verify the sorting or punching of punched cards by looking through the pattern of punched holes.

sign — 1. A symbol that distinguishes negative from positive quantities. 2. A binary indicator of the position of the magnitude of a number relative to zero.

signal — 1. A visible, audible, or other conveyor of information. 2. The intelligence, message, or effect to be conveyed over a communication system. 3. The physical embodiment of a message or of information. 4. An electrical wave used to convey information. 5. An alerting signal; that is, an acoustic device (such as a bell) or a visual device (such as a lamp) that calls the attention. 6. To transmit an information signal or alerting signal. 7. The event, phenomenon, or electrical quantity that conveys information from one point to another. 8. A current used to convey information, either digital, analog, audio, or video. 9. An electrical impulse of a predetermined voltage, current, polarity, and pulse width. 10. Any electronic visual, audible, or other indication used to convey information. In semiconductors, an electrical quantity (typically voltage, current, or light level) corresponding to some physical quantity. Signals are coded in frequency or amplitude to separate them from unwanted noise.

signal attenuation — The reduction in the strength of electrical signals.

signal averaging — A technique for extracting a signal waveform (generally a time-varying voltage) from a background of unwanted noise. Simple frequency-domain filtering with passive or active circuit elements is the most widely used method for accomplishing this result. But this type of filtering is effective only when the frequency spectrum of the signal and the frequency

spectrum of the noise do not overlap. A signal averager is a special kind of filter, sometimes referred to as a comb filter. It can be used effectively only if the desired signal, with its contaminating noise, can be repeated a number of times. In addition, a synchronization of that pulse must have a fixed time relationship to the desired signal, preferably, but not necessarily, ahead of the signal.

signal-averaging computer — An electronic averager that filters out signals of interest from background noise.

signal bias — A form of teletypewriter signal distortion brought about by the lengthening or shortening of pulses during transmission. When marking pulses are all lengthened, a marking signal bias results; when marking pulses are all shortened, a spacing signal bias results.

signal-carrier FM recording — A method of recording in which the input signal is frequency modulated onto a carrier, and the carrier is recorded on a single track at saturation and without bias.

signal conditioner — A device placed between a signal source and a readout device for the purpose of conditioning the signal. Some examples are damping networks, attenuator networks, preamplifiers, excitation and demodulation circuits, converters for changing one electrical quantity into another (such as voltage to current), instrument transformers, equalizing or matching networks, and filters.

signal conditioning — 1. To process the form or mode of a signal so as to make it intelligible to, or compatible with, a given device, including such manipulation as pulse shaping, pulse clipping, digitizing, and linearizing. 2. Any operation that prepares a transducer signal for subsequent display or control functions. Depending on the application, a transducer signal might require any one or a combination of several conditioning operations such as filtering, amplification, isolation, integration, differentiation, and rectification. For extracting low-level signals from electrical noise, an instrumentation amplifier is often the best choice.

signal conductor — An individual conductor used to transmit an impressed signal.

signal converter — A circuit that reduces, filters, and (if necessary) rectifies incoming signals to logic system levels.

signal delay — The transmission time of a signal through a network. The time is always finite, and it may be undesired or purposely introduced.

signal diode — 1. A semiconductor diode used for the purpose of extracting or processing information contained in an electrical signal that varies with time and may be either analog or digital in nature. 2. A diode that exhibits an asymmetrical voltage-current characteristic and is used for signal detection.

signal-distortion generator — An instrument furnished and designed to apply distortion on a signal for the purpose of ranging and adjusting teletypewriter equipment or for furnishing a clear signal.

signal dropout — The loss of signal that occurs when the signal becomes too weak to be usable.

signal electrode — The electrode from which the signal output of a camera tube is taken.

signal element — Also called a unit interval. That part of a signal which occupies the shortest interval of the signaling code. It is considered to be of unit duration in building up signal combinations.

signal encoding device — A system component located at the protected premises that will initiate the transmission of an alarm signal, supervisory signal, trouble signal, or other signals the central station is prepared to receive and interpret.