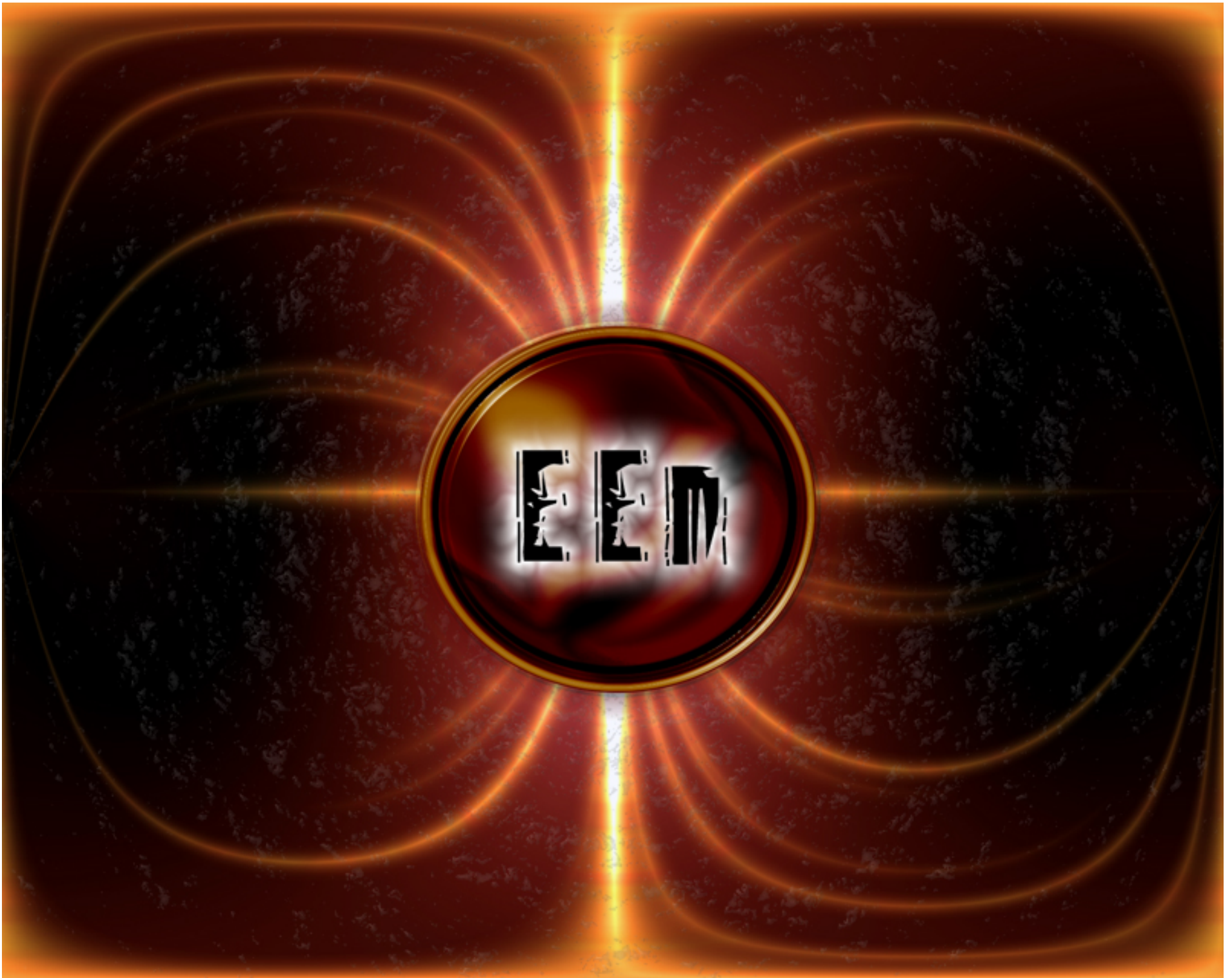




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Preface

One can only appreciate the magnitude of effort required to develop a dictionary by actually experiencing it. Although I had written nine other books, I certainly did not know what I was getting into when in January of 1996 I agreed to serve as Editor-in-Chief for this project. Now, after 2 1/2 years I understand.

Unlike other books that I have written, creating this dictionary was more a test of will and stamina and an exercise in project management than mere writing. And although I have managed organizations of up to 80 academics, nothing is more like “herding cats” than motivating an international collection of almost 200 distinguished engineers, scientists, and educators scattered around the globe almost entirely via email. Yet, I think there is no other way to undertake a project like this. I still marvel at how Noah Webster must have managed to construct his English Dictionary without the benefits of modern communication.

But this project, as much as it is a monument to individual will, is really the collaborative work of many brilliant and dedicated men and women. This is their dictionary and your dictionary.

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amplitron a classic crossed-field amplifier in which output current is obtained primarily by secondary emission from the negative electrode that serves as a cathode throughout all or most of the interaction space.

amplitude descriptor of the strength of a wave disturbance such as an electromagnetic or acoustic wave.

amplitude equations a form of the Schrödinger equation that describes the evolution of a quantum mechanical system in terms of only the coefficients of the preferred basis states. These coefficients are known as quantum mechanical amplitudes and contain both magnitude and phase information. Amplitude equations are often used to gain physical insight into interactions of quantum systems with electromagnetic fields. *See also* [Schrödinger wave equation \(SWE\)](#).

amplitude linearity qualitative measure of the extent to which the output amplitude of a device is a faithful reproduction of its input, with no new frequency harmonics added. A perfectly linear device would output a scaled version of its input, where the shape of the input waveform has been unaltered (i.e., there is no distortion of the input waveform). Viewed in the frequency domain, the output signal would contain only those spectral components found in the input signal, and each frequency line would be scaled by the same amount (i.e., by the gain of the device).

amplitude modulation (AM) the process of modulating a signal $x(t)$ by a carrier wave $c(t)$ for transmission:

$$y(t) = c(t)x(t),$$

where $y(t)$ is the signal to be transmitted. $c(t)$ is either a complex exponential of the form

$$c(t) = e^{j(\omega_c t + \theta_c)}$$

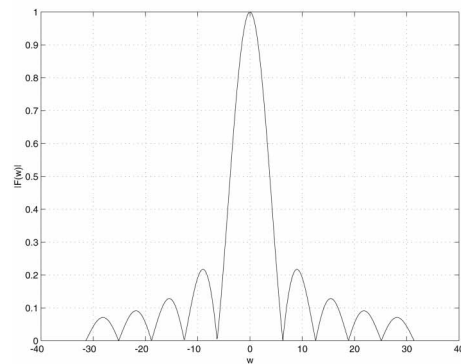
or a sinusoidal signal of the form

$$c(t) = \cos(\omega_c t + \theta_c).$$

ω_c is referred to as the *carrier frequency*. AM has the effect of shifting the frequency spectrum of $x(t)$ by ω_c . The signal is recovered by shifting the spectrum of $x(t)$ back to its original form. *See also* [frequency modulation](#).

amplitude response the magnitude of the steady-state response of a fixed, linear system to a unit-amplitude input sinusoid.

amplitude spectrum the magnitude of the Fourier transform $|F(\omega)|$, $-\infty < \omega < \infty$ of a signal $f(t)$. For example, the amplitude spectrum of a rectangular pulse of unit width is given in the following figure: *See also* [Fourier transform](#).



Amplitude spectrum.

amplitude stabilization circuit a circuit used to obtain a precise oscillation amplitude of oscillators. These circuits are used in instrumentation when it is required to increase the purity of output signal and reduce the frequency depression (especially in Meachem-bridge oscillator with crystal) of the main harmonic by higher harmonics (van der Pol effect). Three types of circuits are used:

1. An element of large inertia (tungsten lamp, thermistor) is included in the circuit at a point where it can change the magnitude of feedback, but not affect the frequency.

frequency distortion caused by the presence of energy storage elements in an amplifier circuit. Different frequency components have different amplifications, resulting in frequency distortion, and the distortion is specified by a frequency response curve.

frequency division duplex (FDD) a technique based on the allocation of two separate frequency bands for the transmission in both directions in a link. FDD typically requires a guard band between the two frequency bands in order to eliminate interference between the transmitter and receiver at a terminal. In a full duplex communication system, information flows simultaneously in both directions between two points.

frequency division multiple access (FDMA) a multiple-access technique based on assigning each user a unique frequency band upon which transmission takes place. *See also* [time division multiple access](#), [code division multiple access](#).

frequency division multiplexing (FDM) refers to the multiplexing of signals by shifting each signal to a different frequency band. *See also* [frequency division multiple access](#).

frequency domain storage an optical data storage technique in which individual bits are stored by saturating or bleaching spectral holes into an inhomogeneously broadened absorption spectrum. Usually, this hole burning is accomplished using electromagnetic fields of discrete frequencies. The maximum frequency domain storage density is given by the ratio of inhomogeneous width to homogeneous width of the absorption spectrum.

frequency hopping a system where the carrier frequency used for modulation is changed according to some predetermined hopping pattern. The receiver hops according to the same pattern in order to retrieve the information. If the rate of change is lower or equal to the data rate, the process is known

as slow frequency hopping, otherwise as fast. Frequency hopping is used for counteracting intentional interference, frequency selective fading, and as a multiple access technique (FH-CDMA).

frequency independent antenna antenna with very large bandwidths. Upper frequency can be about 40 times higher than the lower frequency. Examples: spiral and log periodic antennas.

frequency modulation (FM) angle modulation in which the instantaneous frequency of a sine-wave carrier is caused to depart from the carrier frequency by an amount proportional to the instantaneous value of the modulating wave.

frequency nonselective channel a radio channel that has a uniform transfer function over the bandwidth of information signal. In such a channel, fading leads to reduced SNR at the receiver, but does not lead to distortion of the symbol shape and hence intersymbol interference.

frequency pulling shift of the frequency of a laser oscillation mode from the empty cavity or nondispersed cavity frequency toward the center frequency of the amplifying transition.

frequency regulation the change in the frequency of an unloaded generator with respect to its frequency in a fully-loaded state. Typically applied to small, isolated power systems such as emergency power units.

frequency relay a protective relay which monitors the frequency of the electric power system.

frequency resolution a measure of the ability of a system to resolve different frequencies in a signal. As the frequency resolution increases, more finely-spaced frequency components can be resolved. The time resolution of a system is roughly inversely pro-

phase matching the condition that the phase of the nonlinear polarization bears a spatially fixed relation to that of the optical field generated by the polarization. This condition is a requirement for high efficiency in nonlinear optical generation processes.

phase modulation a type of angle modulation whereby information is encoded onto a carrier wave by modifying its phase angle as a function of time in proportion to the intelligence signal amplitude.

phase modulator a device that alters the phase of a signal.

phase noise frequency variation in a carrier signal that appears as energy at frequencies other than the carrier frequency.

phase only binary filter transmission or reflection phase plate in which neighboring regions differ in phase shift by π radians.

phase parameter complex parameter representing corrections to the gain and phase of a Gaussian beam.

phase plane a two-dimensional state space.

phase plate transparent medium that introduces different phase shifts to different transverse regions of an optical wave for the purpose of introducing or reducing phase or amplitude structure on the wave; often having only two phase shift values differing by π .

phase portrait many different trajectories of a second-order dynamical system plotted in the phase plane.

phase response the way in which a system alters the phase of an input sinusoid.

phase ripple the variation in phase response across the operating bandwidth of an optical or electrical device.

phase sensitive detection See [synchronous detection](#).

phase sensitive measurement measurement in which the phase of an AC signal is tracked in a feedback loop in order to improve detection sensitivity. The most common examples are phase-locked loops in control systems and lock-in amplifier measurements in electronics. In the latter, a small AC signal is added to the bias voltage supply, and this signal is then detected in any measured quantity with an amplifier whose phase can be varied to “lock onto” that of the initial AC signal. This effectively mixes the two AC signals, and their difference (at DC) is used to characterize the measurement. The effective bandwidth is determined by the bandwidth at the DC level.

phase sequence describes the rotational orientation of the voltage phasors in a 3-phase electrical power system. A positive phase sequence, designated by the nomenclature ABC, indicates a 3-phase connection in which the B phase voltage lags the A phase voltage by 120 degrees, and the C phase voltage leads the A phase voltage by 120 degrees. A negative phase sequence, designated by ACB, reverses this relationship so that the B phase leads the A phase, and the C phase lags the A phase. See also [phase sequence indicator](#).

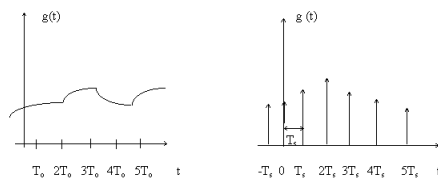
phase sequence indicator device used to detect the phase sequence of a 3-phase electrical power system. See also [phase sequence](#).

phase shift a time displacement of a waveform with respect to another waveform of the same frequency.

phase shifter a device that changes the phase angle between two buses in a power system. Conventional phase shifters are special autotransformers in which each phase voltage is connected in series with a variable component of voltage from another phase.

sample-and-hold circuit a device with a mode control switch that causes reading the input at the instance of the trigger and maintaining that value until the next trigger pulse.

sampling the act of turning a time-continuous signal into a signal that is time-discrete or time-discontinuous. See the following diagrams, where T_S is the sampling period.



The sampling process.

In order to maintain frequency components of interest in the time-discontinuous signal, the Nyquist sampling criterion needs to be satisfied. This criterion states that the rate of sampling of the time-continuous signal has to be at least twice as great as the frequency of the signal component with the highest frequency which is of interest in the time-continuous signal. Sampling is very common in digital recording and digital communication systems.

sampling frequency in analog-to-digital conversion, the rate or frequency at which an analog signal is sampled and converted into a digital signal.

sampling function a mathematical function used when sampling a signal. In particular, a sampling function $S(t)$ can be multiplied by the continuous function to be sampled, $F(t)$, to obtain the sampled version of F . S is most often a collection of equally spaced impulses.

sampling period the period for which the sampled variable is being held constant.

sampling process See [sampling](#).

sampling rate See [sampling frequency](#).

sampling theorem See [Shannon's sampling theorem](#).

SAR See [synthetic aperture radar](#) or [specific absorption rate](#).

satellite cell cell with the radius larger than 500 km where the cell is controlled by a satellite. See also [cell](#).

satellite imagery the acquisition of pictures of the earth from space. Satellite imagery can be used to enhance maps, collect resource inventories (e.g., forestry, water, land use), assess environmental impact, appraise damage following a disaster, and collect information on the activities of humans. Satellite imagery tends to be multi-spectral, including a wide range of optical frequencies and, more recently, infrared and radar. See also [remote sensing](#).

saturable absorber the nonlinear optical phenomenon in which the absorption coefficient of a material decreases as the intensity of the light used to measure the absorption increases.

saturable absorption the effect of there being less absorption in a material for larger values of the incident illumination.

saturated gain value of the gain in a saturable amplifier for a particular value of intensity.

saturated logic logic gates whose output is fully on or fully off, determined principally by the external circuit.

saturating control a controller producing a bounded control signal. Finite limits on the magnitude of the control signals that are provided by the actuators are due to the fact that the actuators are physical devices and as such are subject to physical constraints.

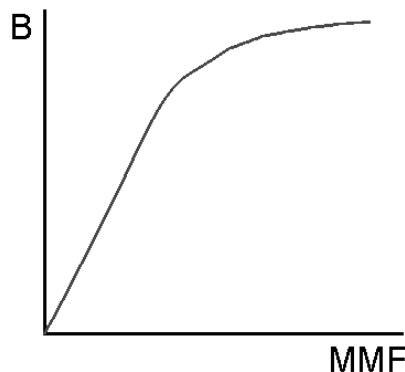
Thus, the actuator saturates, that is, it has “limited authority.”

saturation (1) the failure of the output to increase as fast as the input.

For example, often the current regulator used in variable-speed drives is unable to track the commanded current because of insufficient voltage difference between the motor back EMF and the supply.

In an amplifier, saturation results in a reduction of gain in an amplifier or loss in an absorber due the intensity of the signal being amplified or absorbed.

In ferromagnetic circuits, the magnetic flux initially increases linearly with the applied magnetomotive force (MMF), but eventually most of the domains in the ferromagnetic material become aligned, and the rate of increase in flux decreases as the MMF continues to increase. See figure below. *See also* [saturation flux density](#).



Saturation effect in a ferromagnetic circuit.

(2) with respect to color, the amount or purity of the color seen. A pure color is said to be fully saturated, and the saturation decreases as white is added to the mix. The color “pink,” for example is a less saturated version of “red.”

saturation angle the angular portion of the time-based output signal (in degrees) over which the device is saturated. It is always less than or equal to the conduction angle,

since the device must conduct before it can saturate.

saturation flux density the maximum value of intrinsic induction (B_i) beyond which an increase in magnetizing field yields no further improvement, indicating that all magnetic moments in the material have been aligned.

saturation intensity the intensity of a beam of light above which saturation effects become appreciable. *See also* [saturable absorption](#).

saturation magnetization the magnetic moment per unit volume of a material when the magnetization in the sample is aligned (saturated) by a large magnetic field.

saturation parameter reciprocal of the value of intensity for which the gain of an amplifying medium or the loss of an absorbing medium is reduced to one half of its unsaturated value.

saturation polarization the value to which the externally measured electrical dipole moment of a ferroelectric body tends when subjected to an external electrical field greater than the coercive field.

save instruction an assembly language instruction that saves information about the currently executing process.

SAW *See* [surface acoustic wave](#).

SAW device *See* [surface acoustic wave device](#).

saw-tooth coupler transmission line coupler consisting of two parallel transmission lines placed in close proximity to one another. The adjacent edges of the two transmission lines are shaped in a notch or saw-tooth pattern to equalize the phase velocity of the even and odd mode voltage components.