CONDENSED GLOSSARY OF AUDIO TERMS

by Drew Daniels

- A -

ABSORPTION
The ability of a material to absorb sound energy and reduce sound intensity by converting sound (vibration in air) to heat by means of friction in the material's structure (adiabatic heating).

ABSORPTION COEFFICIENT
The efficiency of a material to absorb sound at a particular frequency (which relates to sound wave length and material thickness). An absorption coefficient of 1.00 indicates total absorption, while a coefficient of 0.00 indicates total reflection. (see also, SABIN)

ACOUSTIC
Related to pressure changes or propagating mechanical waves in air or any other sound transmission medium, that comprise sound in its conventional form, as humans hear it.

ALNICO
An alloy of cobalt, nickel and aluminum used as permanent magnet material in magnetic structures of loudspeakers and microphones. In the early 1980's, alnico was largely supplanted in favor of ferrite in loudspeaker design because of political upheavals in the african countries that produce cobalt, the prime constituent of alnico.

AMBIENCE
The distinctive acoustical characteristic of a room or acoustic space due to the many sound reflections in the space. For example, rooms that are said to be acoustically "dead" lack ambience.

AMPERE
The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to $2X10^{-7}$ (0.0000002) newton per meter of length.

AMPLIFICATION
An increase in signal quantity of either amplitude or power level.

AMPLIFIER
A device which increases the voltage and/or power level of signals fed through it.

AMPLITUDE
The extreme range of a fluctuating quantity, as an alternating current, swing of a pendulum, etc., generally measured from the average or mean to the extreme.

ATTACK
The beginning of a sound or the initial transient of a musical note.

ATTENUATE
Reduce. In audio parlance, to reduce the level of an electrical signal as with a volume control, pot (potentiometer), fader or pad.

AUDIO FREQUENCY
Any frequency which humans hear, typically between a lower limit of about 12 hertz and an upper limit of about 20,000 hertz. This range of audio frequencies is also known as the "audio spectrum."

AUTOFORMER—AUTOTRANSFORMER
A single-winding coil, often on a magnetic core, resembling a transformer in physical appearance. When used for audio, the autoformer is fed a high-level signal such as that from a loudspeaker line, and produces desired changes in voltage at one or more taps along the coil's length. These taps are usually spaced so as to produce specific impedance ratios between inputs and outputs. For example, a 1:2 autoformer connected to an 8-ohm loudspeaker will convert its impedance to either 4 ohms or 16 ohms, depending on which way the connections are made.

AXIS
An imaginary center point. Looking down the center of a horn places the viewer "on axis" to the horn, while moving to the side so that the horn throat is not visible places the viewer "off axis."

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BAFFLE—ACOUSTIC
An absorptive board or sound barricade that can be placed around or between acoustic sources to provide sound isolation or deadening and reduce acoustic leakage between multiple microphones, such as in a recording studio or live musical performance stage setup.

BAFFLE—SPEAKER
The enclosure surface, wall boundary or mounting board on which loudspeaker drivers are mounted.

BALANCED—BALANCED LINE
(see FLOATING)

BAND
In terms of audio frequency, a band is a portion of the audio frequency spectrum in the same way that green is a portion of the visible frequency spectrum. The audio frequency spectrum covers a range of over 10 octaves. The visible light frequency spectrum covers a range of less than 1 octave.

BAND PASS
A set of two filters that attenuate frequencies beyond the frequency limits of a given band of frequencies. The telephone, for example, is a band pass filter that eliminates low frequencies below about 300 hertz and high frequencies above about 5,000 hertz, causing the characteristic telephone sound most people are familiar with.

BAUD
The rate or frequency of data bit or byte transmission in a data transmission line.

BUS or BUSS
Like a bus that may carry many passengers, an audio bus is a wire or circuit that may carry more than one audio signal at a time.

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CAPACITOR
An electronic circuit component part designed to store electricity. The value of such a part in farads (F) is a measure of the amount of electricity that can be stored. A theoretically ideal capacitor with a one-farad capacity is charged, from a discharged state, to a voltage of one volt, by applying a current of one ampere for a period of one second. Capacitors are made of two metal conductors separated by a non-conducting dielectric material such as paper, oil, glass, air, mylar, polypropylene, polystyrene, etc.

CARDIOID
Heart-shaped. Pronounced "car-dee-oid," in terms of microphones, refers to the relative sensitivity of the microphone with respect to the angle from which sound strikes the front (on-axis). Cardioid microphones decrease gradually in sensitivity as they are rotated away from the source of sound they are aimed at. Cardioids perform best if their off-axis frequency response is similar to their on-axis response.

CENTER FREQUENCY
The particular frequency at which the most boost or cut is available in a peak-dip type equalizer such as a graphic type, or a notch filter or parametric type.

CHANNEL
The individual audio signal path through a system which has more than one such path or as in the case of a single-channel amplifier a device which passes signals along only one electrical path.

CLIPPING
A distortion of audio signals caused by input signal peaks or voltage amplitudes which cause a circuit to attempt to exceed its own maximum voltage capabilities.

COMPRESSOR
An audio amplifier whose output amplification rate of change is less than its input signal amplitude rate of change. Compressors are used to reduce the dynamic range of program signal either to make everything sound louder, or to automatically control sudden large changes in signal amplitude as in the case of recording vocalists. Compressors sometimes include circuits that allow the user to adjust the time it takes to start compressing (attack), to ease up on the compression (release), and also the input and output gain. (see also, LIMITER)

COMPRESSION DRIVER
A loudspeaker designed specifically to drive a horn, matching the horn's acoustic impedance to achieve higher efficiency.

CONDENSER
(see CAPACITOR)

CORNER FREQUENCY
The frequency that defines the lower or upper limit of an audio frequency band, and where the power level is half of that in the middle of the band or "center frequency."

COULOMB
The coulomb is the quantity of electricity transported in 1 second by the current of 1 ampere.

CROSSOVER—ACTIVE, or ELECTRONIC
An electronic device which filters and selectively amplifies frequencies, separating the frequencies into sections or bands, and routing them to outputs designed to drive power amplifiers and in turn, speakers. The frequencies filtered depend on the electrical value of the component parts in the circuits of the device, but not on the source or load impedances connected to the device, except in the case where the crossover is actually a

passive crossover designed for insertion in the medium-level signal lines of an audio system rather than in speaker lines.

CROSSOVER—PASSIVE, or HIGH-LEVEL
An electrical device composed of coils of wire (inductors) and electrical capacitors, that separates audio frequency bands by filtering action and routes them to different places (such as a woofer and a tweeter). The frequency of the crossover's action is determined by the value of the electronic components inside, and by the loudspeaker driver's impedance in ohms, which implies that replacing a 16-ohm driver in a particular system with an 8-ohm driver, will change the crossover frequency; in such a case, the frequency will rise an octave and the shape of the crossover frequency response slopes will be distorted.

CROSSTALK
The leakage between audio signal carrying channels, typically heard as bleed-over between left and right stereo speakers, or as leakage of high-frequency sound between busses or circuits in audio mixers, microphone cable snakes, and multiple circuit audio signal wiring. Crosstalk is often caused by the electrical coupling by capacitance between the metal traces on printed circuit boards or the proximity of conductors in mixer wiring harnesses.

CUE
Also called "foldback," cue is a portion of audio signal in a system which is diverted and used for pitch and tempo reference by musicians or for timing reference by voiceover announcers for jingle production and motion picture dialog replacement dubbing (as from monitor speakers or headphones). The term "cue" is also used to describe the circuits within an audio mixer unit or an audio system designed to provide this reference.

CUTOFF FREQUENCY
All audio systems are limited to a band of frequencies in which they can do useful work. The frequencies are defined as the corner frequencies of a filter. Since for example, an amplifier cannot reproduce infinitely high notes, it is a low-pass filter whose cutoff frequency is the point (in hertz) where it can no longer produce full-power output, and where the actual output power falls to half the midband power or 3 decibels below the reference full- power output at midband (-3 dB point).

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DAMPING or DAMPING FACTOR
The difference or ratio of an amplifier's output impedance and the impedance of the driven load. For example, an amplifier whose output impedance is 0.8 ohm driving a speaker whose impedance is 8 ohms has a damping factor of 10, while an amplifier whose output impedance is 0.08 ohm driving an 8-ohm speaker gives a damping factor of 100. Inserting a speaker cable whose resistance is .08 ohms in series with an 8-ohm speaker and an amplifier with a .08-ohm output impedance lowers the overall system damping factor to 50 (8 divided by .16).

DECIBEL or dB
A comparison of two similar values, like apples vs. apples, oranges vs. oranges or volts vs. volts. A voltage doubling (or halving) produces a 6 dB increase (or decrease), and a power doubling (or halving) produces a 3 dB increase (or decrease). The amount of power increase required for us to hear a twice-as-loud increase is +10 dB. The amount of power decrease it takes for us to hear a half-as-loud decrease is -10 dB. Thus to produce sound twice as loud as that produced by a 100-watt amplifier would require a 1,000-watt amplifier.

The dB is a power ratio. Calculating dB for power is done by multiplying the difference between two numbers by 10 times the base-10 logarithm of the numerical ratio.
For example:

50 watts = $10\text{Log}_{10}(50/1)$ = 16.99 dBW or 16.99 dB above one watt.

Quantities that are calculated using $10\log_{10}$ are:

Watts	Energy level
Illuminance	Intensity level
Power level	Energy density level

Quantities that are not power ratios must be calculated using 10log20 as the multiplier. These include:

Volts	Vibratory acceleration
Amperes	Vibratory velocity
Sound pressure level	Vibratory force

VOLTS	dBV	dBu	WATTS	dBm	dBW
.02449	-32.2	-30	.0001	-10	40
.03162	-30	-27.8	.001	0	-30
.07746	-22.2	-20	.002	3	-27
.1	-20	-17.8	.01	10	-20
.24495	-12.2	-10	.1	20	-10
.31623	-10	-7.8	1	30	0
.77459	-2.2	0	10	40	10
1.0	0	2.2	100	50	20
10.0	20	22.2	1000	60	30

There are several significant decibel variations used in audio:

dB - used alone as reference for level changes.
dBV - ratio of volts referred to one volt.
dBu - ratio of volts referred to 0.7746 volt.
dBm - ratio of watts referred to one milliwatt.
dBW - ratio of watts referred to one watt.
dB SPL - ratio of sound pressures referred to 20 micropascals.

NOTE: dBm should not be use to denote a voltage, since that implies that a specific load impedance is known. dBm improperly used where dBu should be used must, therefor, include a statement of circuit dependency on a 600-ohm load, since dBm and dBu are equal only if the 1 mW dBm reference is driving a 600-ohm load:

watts = volts^2/ohms, $\therefore$ 0.7746 volt^2 = 0.6/600 ohms = 0.001 watt

DECAY
The fading away of a musical note after its onset or attack. In acoustics, the time it takes for echoes and reverberation to fade away. The term "RT_{60}" is used to describe the reverberation time of a room or acoustical space under study when a period of time has elapsed after a calibrated noise excitation is stopped, until the reverberation in the room drops to a sound pressure level 60 dB below the reference level of the excitation. RT_{60} values of 5–10 seconds are typical of large cathedrals, RT_{60} between 1–5 seconds are typical of churches or gymnasiums and RT_{60} values between .1 and 1 second are typical of recording studios.

DIAPHRAGM
The moving part of a loudspeaker, particularly compression drivers and tweeters. The part of a loudspeaker that actually pushes on the air causing air motion.

DIFFRACTION

The phenomenon of sound waves bending around objects which are small compared to the length of the waves (see WAVELENGTH). Objects such as posts tend not to affect bass sounds but will shadow higher pitches (frequencies) to the extent that listeners will not hear tweeters that are not visible from their listening position.

DISPERSION
The directional pattern of sound radiation from a loudspeaker. The dispersion of horns is controlled by the horn's mouth walls, the overall size of the mouth and the length of sound waves emanating from the mouth. Low frequency loudspeakers normally radiate omnidirectionally at low frequencies, gradually forming beams of sound as frequency rises and sound wavelength becomes a smaller fraction of the loudspeaker's diameter. (see WAVELENGTH)

DISTORTION
An alteration in the shape, voltage, phase, timing relationships and frequency response of an audio signal caused either intentionally or unintentionally by circuitry that is driven to overload, or by poorly designed audio components such as microphones, mixers, effects, crossovers, amplifiers or speakers which do not accurately reproduce signals fed through them. (see OVERLOAD)

DIRECTIVITY
Directivity is a measure of the output of loudspeakers or horns based on the included angle within which the sound pressure level drops no more than 6 dB (one-quarter power). For example, a horn which covers a horizontal angle of 90 degrees (a quarter circle) where the two 45 degree off-axis points are 6 dB quieter than the on-axis measurement is said to have a (horizontal) "Q" of four, because it directs sound from what would have been an omnidirectional radiator (the horn's driver) into a quarter circle. Vertical directivity is derived in the same manner as is horizontal directivity, but the two figures are usually printed as two separate pieces of information on horn specification sheets since most horns radiate into different horizontal and vertical angles. A horn whose output covers angles of 90 degrees both horizontally and vertically, or one-quarter of a sphere, is said to have a total Q of 4, and a DI (Directivity Index) of 6 dB, since the same acoustical power from an omnidirectional radiator, forced to radiate into a quarter-sphere, is 6 dB louder at the same distance from the source than it would be radiating omnidirectionally, producing four times the apparent acoustical power to an observer such as a measurement microphone.

DIVIDING NETWORK
(see CROSSOVER)

DOPPLER EFFECT
For sound in air, the Doppler Effect takes the form of a shift in pitch which is proportional to the speed of any movement between a sound source and a listener such as the shift in the whistle on a passing train or the bells on a passing ice cream truck. In the same manner, a loudspeaker cone reproducing bass frequencies with their attendant long cone excursions will add a vibrato to any high-frequency tones being simultaneously reproduced by the same cone. The vibrato's rate will be that of the frequency of the lower reproduced pitch or pitches, and the vibrato depth will depend on the particular pitches that are interacting and the amplitude of low-frequency cone excursions. This vibrato is also called Doppler distortion, and is cited as one of a number of compelling arguments in favor of multi-way speaker systems.

DRIVER
Another name for loudspeaker; the word "driver" is used by non-engineers to designate a compression driver like those used to drive horns for acoustic amplification and directional control of sound.

DRY
An audio signal or sound without reverberation. An audio signal or sound with reverb is called "wet."

DUCT or DUCTED PORT
A tube attached to a speaker enclosure to "tune" and define the lowest usable frequencies of the enclosure. Like a bottleneck, a duct produces one distinct tuned pitch determined by its size relative to enclosure size. Such tuning is virtually independent of the bass driver mounted in the box, but grossly affects performance both in terms of frequency response and distortion.

DYNAMIC RANGE
The difference, in decibels, between the loudest and the quietest passages in a musical or audio program. Also, the difference between the maximum signal level that can be produced under nominal operating distortion levels by an electronic circuit, and that circuit's obnoxious noise level (called the "noise floor").

DYNE (per square centimeter)
An obsolete term used to designate 0.1 pascal, or 74 dB SPL (Sound Pressure Level). Also a unit of pressure equal to 0.1 newton per square meter. (see SPL chart on last page)

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ECHO
Any or all audibly discrete delayed sound images. In contrast, reverberation produces a wash of sound, with no discrete echoes.

ECHO BUSS
A typically dedicated audio channel within an audio mixing console, through which is routed signals intended to be sent or received to or from an echo or reverberation device such as an echo chamber.

EDDY CURRENT
Electrical currents caused in electrical conductors (metals) by the presence of magnetic field variations. These eddy currents in turn cause local magnetic fields which act counter to the fields producing them. Most electric power meters are eddy current motors which rotate in direct proportion to the amount of current (amperes) flowing through them. Loudspeakers and transformers are designed to avoid or take advantage of eddy currents to enhance performance.

EFFECTS
Effects devices can be broadly classified as anything that changes the sound of signals passing through them. In this sense, a distorted amplifier is an effects device, although effects are usually thought of as the product of one of the following:

limiter	filter	compressor
expander	equalizer	graphic EQ
noise gate	parametric EQ	tone control
VCO	VCA	envelope filter
envelope generator	echo	reverb
digital delay	digital reverb/echo	phasor
flanger	exciter	de-esser
stresser	parametric limiter	direct box
preamplifier	octave divider	vocoder
boom-box		

EFFICIENCY
Generally, efficiency is the ratio of input and output. Efficiency is usually expressed in percent, thus a loudspeaker which produces 8 acoustic watts when fed 100 electrical watts is 8% efficient, this would represent quite a high efficiency for a cone type loudspeaker. Typical hi-fi speakers and studio monitors range between 0.01 percent and 2 percent efficiency in their ability to convert electrical watts to acoustical watts. Power amplifiers give typically 50 to 98 percent efficiency, converting 60 hertz A.C. line power into audio frequency A.C. power.

EIGHTH SPACE
One eighth of a sphere. An acoustic boundary condition where the corner of a room causes low-frequency radiation from a speaker to be folded onto itself three times; once from the floor and once from each wall, producing a 9 dB increase in sound pressure over what the source would measure if hung in free space away from reflecting surfaces.

ELECTRET
A permanently electrically polarized microphone diaphragm used in place of an external high voltage supply to allow condenser microphone operation by the variable capacitor method.

ELECTROMAGNET
A magnet formed by the presence of electrical current in a coil of wire. A loudspeaker's voice coil is an electromagnet which alternately attracts and repels the permanent magnet in which it is situated, in response to the alternating electrical input from a power amplifier.

ELECTRONIC CROSSOVER
(see CROSSOVER—ACTIVE, or ELECTRONIC)

ENCODE — ENCODED
Alteration of audio signals prior to recording on tape, discs or other recording media. The alteration usually consists of pre-equalizing the incoming audio signals so that media noise is unaltered but signals on the media contain more high frequency energy, and often compressing the incoming audio signal so that less dynamic range is required of the media to store the audio signals. Decoding is normally the exact reverse of the encode functions, allowing signals to be re-expanded by a greater amount than normal expansion of the intrinsic playback noise of the recording medium.

ENVELOPE
The trend of waveforms that forms a composite waveform that may contain all the frequencies and signal components, sidebands and interactions of the signals in the envelope.

EQUALIZATION or **EQ**
The intentional alteration of levels of portions of the audio frequency spectrum to fit the requirements of frequency response defined by a listener. Traditionally the term equalization was used to describe the replacement (always a boost) of energy lost as a result of long telephone line runs of wire, but today the term is used to describe any change in frequency response or spectral balance done intentionally by using any device which includes circuits that can produce these changes.

EQUALIZER
An electronic circuit or device that selectively increases or decreases gain as a function of frequency. An equalizer may boost or cut only, or may do both. It may be a fixed circuit such as the equalizer in a phonograph preamp that restores the frequency response of a phono cartridge's output to flat from the record's normal non-flat output, or the equalizer may be a sophisticated self-contained device that allows user adjustment of frequency selection or continuous frequency tuning, bandwidth or Q and amount of boost or cut (parametric equalizer).

ERASE HEAD
A magnetic tape head used to remove recorded signals from tape using a high-level, high frequency bias signal that is turned on when a tape recorder's record circuits are active.

EXPANDER
An electronic device that makes loud signals louder and quiet signals quieter, thus expanding the dynamic range of the original signals.

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FADER
An electronic component such as a potentiometer, or a circuit such as a voltage-controlled amplifier, that varies the amplitude of all the audio signals passing through it. Faders can be physically linked to the user's control by straight line knobs as with linear faders, rotary knobs such as those on trim and monitor controls or by means of computer and digital-to-analog converters that supply the necessary control voltage to operate the voltage-controlled amplifier circuit comprising a VCA fader.

FARAD
The farad is the capacitance of a capacitor between the plates of which there appears a difference of potential of 1 volt when it is charged by a quantity of electricity equal to 1 coulomb.

FEEDBACK
A portion of a signal which is fed into the audio signal chain or signal-carrying circuits, either in-phase or out-of-phase with the main portion of the signal, causing a reduction or increase of signal level in the system or circuits. In acoustic situations with microphones and speakers near each other, in-phase or "positive" feedback causes the familiar howling sometimes heard when too much system gain leads to recirculating sound build-up between mic and speaker. In electronic situations such as amplifiers, out-of-phase or "negative" feedback is put to use in the amplifier's circuits to reduce distortion, and lower output impedances.

FERRITE
A mixture of ceramics, iron powders or oxides, barium or strontium carbonate or other elements such as rare earths, which is cast and sintered (heated) and used as magnetic material to make permanent magnets or transformer or inductor cores. Ferrite magnets are also known as "ceramic magnets."

FET
Field Effect Transistor. A special type of transistor noted for its very high input impedance and linear operation, as compared to common bipolar transistor types which have lower input impedances and require higher bias currents to operate. Field Effect Transistors exhibit some of the operating characteristics of vacuum tubes which suits them for applications where tubes may have been favored over bipolar transistors.

FIDELITY
As with the common definition of fidelity, true to (the original), the term is used to describe the accuracy of the reproduction of audio signals by audio devices and components usually as the sound ultimately heard from the sound system by the listener.

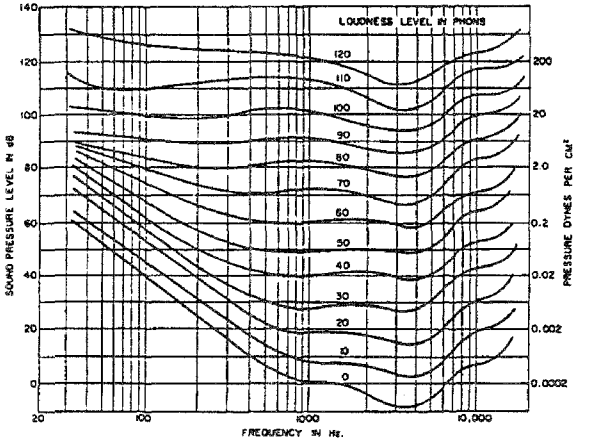
FIGURE EIGHT
The sensitivity vs. direction or angle pattern of a bipolar microphone or loudspeaker, as described on a rotating graphic level recorder chart by a pen responding to changes in level caused by the rotation of the device past a stationary sound source, or in the case of the bipolar speaker, a stationary measuring microphone.

FILTER
A circuit that selectively attenuates portions of the audio frequency spectrum. A filter is the opposite of the traditional equalizer, which selectively boosts, but for the purposes of modern convenient control of sound on mixers and equalizer units, the circuits of tone-altering controls usually incorporate the dual abilities to equalize and filter by simply rotating a knob one way or another.

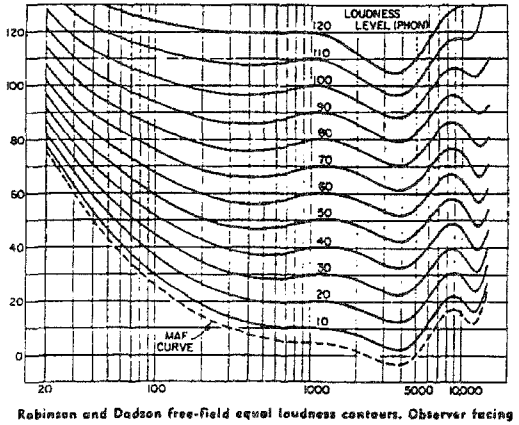
FLAT (Frequency Response)
The common term used to denote circuits, devices or audio systems that pass signals of different frequencies with equal amplitude over some range of frequencies (typically 20 hertz to 20 kHz for the audible range).

FLETCHER-MUNSON CURVES

One of several published sets of curves that graphically show how our ears perceive equal loudness for changes in frequency and for changes in sound level. Our ears are not flat and do not hear in a linear manner. At the normal threshold of hearing for humans (0 dB SPL or Sound Pressure Level), it takes some 10,000 times more acoustic power to enable us to hear a 20 hertz pure tone than it does to hear a 4000 hertz tone, while at 90 dB SPL, it requires only about twelve times more power to achieve the same relative perception of volume.



Fletcher-Munson curves (USA). (Courtesy, Acoustical Society of America)



Robinson and Dadson free-field equal loudness contours. Observer facing the source of sound.

FLOATING
A circuit which passes signals without reference to a ground. Typically, a floating audio circuit is characterized by a three-wire configuration called a "balanced line" where two wires carry the audio information and one wire acts as an electrostatic shield. The two shielded conductors of such a cable both carry equal voltage potentials of opposite polarity, from their driving source to their driven input, and so share a balanced voltage with respect to a neutral or imaginary reference. Electromagnetic radiation striking both signal carrying conductors at once is canceled by the input of the device being fed by virtue of the fact that the input circuit responds only to the differential voltage of the two signal carrying conductors, and the electromagnetic interference appears equally on both conductors, producing no differential voltage at the input. The reference wire or shield, may or may not be grounded, depending on ground loop currents that may be amplified causing hum in the system. Often, grounding is accomplished by mechanical connection of audio component chassis within a metal rack enclosure, in which case shielded wiring is unnecessary for balanced inputs and outputs.

Early telephone technology used transformer balanced inputs where a center tap of the transformer winding was grounded to dump electrostatic potentials. This type of wiring used an actual ground connection as the zero-voltage reference against which the two signal carrying conductors were balanced, thus enabling use of simple twisted pair, unshielded conductors for transmission of signals over long land lines where shielded cable would have proved prohibitively expensive but immunity to radio interference was required.

FLUTTER
Output amplitude variations from an audio reproducer such as a tape or record player due to one of several types of mechanically-based problems. Flutter may consist of simple amplitude modulations (AM) in output caused by rough tape handling or out-of-round idlers, or may take the form of frequency modulation (FM), small pitch variations, from bent or unevenly machined capstans or drive motors, pulleys or belts. AM components of flutter may also include tape modulation noise caused by uneven magnetic coatings or amplitude variations caused by loose magnetic oxide particles preventing good tape-to-head contact. FM components of flutter may also include scrape noise from tape-to-head, tape-to-tape guide or tape to flutter idler contact. Flutter is usually thought of as rapid variations of 10 hertz or more, and in fact, FM flutter components often extend up into the upper frequencies of the audio range. Very low frequency phenomena of a similar nature are called "wow," and are characterized by the 0.56 hertz pitch variations of 33-1/3 revolution/minute records with off-center spindle holes.

FOLDBACK
(see CUE)

FOLDED HORN
A horn whose internal path length is folded to produce a more compact package.

FREQUENCY
The spacing in time, of events. In audio signals, frequency refers to the cyclic repeat of vibrations. In wire, the vibrations are electrical variations. In air, the vibrations are changes in air pressure. The ear hears air pressure variations with frequencies between about 12 times per second and 20,000 times per second or 12 Hz (hertz) and 20 kHz (kilohertz).

FREQUENCY DIVIDING NETWORK
(see CROSSOVER)

FREQUENCY RESPONSE
A measurement of how a device being measured responds to test signals of constant amplitude without regard to frequency, over a particular measurement range of frequencies. An electrical device whose specifications say it is "flat from 20 Hz to 20 kHz," will not cause any amplitude deviation in signals fed through it over that frequency range, as a result of changing the frequency of the test signal.

FULL SPACE
A sphere. An acoustic condition where there are no boundaries to reflect sound. A sound source hung in free space away from reflecting surfaces does not exhibit the same bass boost as it would if set on the floor or against a wall. (see HALF SPACE and QUARTER SPACE)

FUNDAMENTAL
Any pure tone. The pitch remaining when all harmonics (overtones) are removed from a basic frequency or musical tone, producing a pure tone. An amplifier or audio circuit that can pass a pure tone without adding any harmonics of its own is said to have low harmonic distortion.
Musical instruments usually produce tones rich in harmonics, giving each its particular sound or "timbre." Small loudspeakers will be heard to reproduce bass instruments even while producing little or no fundamental pitch because the ear and brain reconstruct the sound of the instrument based on prior knowledge of its timbre.

- G -

GAIN
An increase. Amplifiers produce gain by increasing voltage and/or current. Horns produce acoustical gain by concentrating the sound of loudspeakers to narrower angles and frequency ranges. Gain is specified in decibels (dB), and while an amplifier may be used to produce unity gain, or a net increase of 0 dB in voltage, it may produce some current gain.

GAUSS
The obsolete term denoting a magnetic flux density of 0.0001 tesla. The SI unit, tesla (T) is equal to one weber per square meter. The weber (Wb) is the unit of magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of one volt as it is reduced to zero at a uniform rate in one second.

GROUND
In electronic equipment, ground is the zero voltage reference point in the circuitry. Ground is referred to as earth because true ground on power lines is provided by a heavy electrical conductor such as a copper bar, driven into the earth to make an electrical return path. This is why you become "connected" to ground when standing in water and are subject to shock from electrical equipment that is not also properly grounded.

GROUND LOOP
An electrical circuit where two or more paths to ground (true 0 volts) have different voltages as a result of current flow through wiring or chassis elements. The minute voltages on some ground legs may find their way into equipment input circuits and be amplified, causing hum, buzzing or in the worst case, inaudible high frequency oscillations, sometimes at high power levels, that can ultimately cause destruction of tweeter voice coils or even burn out amplifiers.

Ground loops are eliminated by tracing the small unwanted voltages with an oscilloscope to find and isolate their sources from other circuitry. Often, shields must be disconnected or chassis modified to prevent poor packaging designs from causing ground current flow. Sometimes, modifying internal wiring is the only thing that will eliminate a ground loop.

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HAAS EFFECT
The effect of single strong echoes masking the real direction of sound sources. First described by Helmut Haas, the effect bears on our ability to discern sound source direction and understand speech consonants, in particular, when loudspeakers used for sound reinforcement produce sound arrivals before the original source (talker) or when these arrivals are too loud with respect to the original source.

HALF SPACE
One half of a sphere. An acoustic boundary condition where a surface causes low-frequency radiation from a speaker to be folded onto itself (the same acoustic power filling only half the amount of space), producing a 3 dB increase in sound pressure over what the source would measure if hung in free space away from reflecting surfaces.

HARMONIC DISTORTION
Distortion which is harmonically related to the fundamental signal fed through and audio circuit or system. Harmonic distortion is characterized by a harsh sound that ranges from a slight edge on some of the high-frequency components of a musical program, to the fuzz associated with electric guitar effects pedals.

HEADROOM
The reserve voltage or power level in an audio device or system. The difference in levels between the normal or "nominal" operating levels and the peak clean (undistorted) available levels. (see also NOMINAL OPERATING LEVEL)

HENRY
The henry is the inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 ampere per second.

HERTZ
The term hertz, abbreviated **Hz**, replaces the formerly used "cycles per second" or "cps." Named after Heinrich Hertz, the term applies to any regular, cyclic vibration or event. The term hertz always involves time (seconds) no matter what the period between repetitions of the event of interest; for example, a tone vibrating 1,000 times every second is said to be at a frequency of 1,000 hertz or 1 kilohertz (kHz). The earth spinning once around every day (86,400 seconds) rotates at a frequency of 11.6 microhertz (μHz).

HIGH CUT
(see LOW PASS)

HIGH PASS
A circuit or filter that stops low frequencies and passes high frequencies. A typical high pass filter use is protection of tweeters and compression drivers from the effects of over-excursion of their moving diaphragms. Low pass filters are used to attenuate or eliminate high frequencies from the drive to woofers so that they can operate in the frequency range where they are most linear (see LOW PASS).

HISS
The unwanted random noise associated with audio tape, unmodulated record grooves and noisy amplifiers and other audio circuitry. In circuitry, hiss is caused by the thermal activity of the molecules in the materials that electronic component parts are made of.

HYSTERESIS
The lag of effect or reaction after a stimulus as in the tendency of a magnet to resist being demagnetized or of a piece of iron to become magnetized after a magnetic field from a coil is introduced into it. Hysteresis in magnetic materials provides a means of measuring how well the material will function to provide a particular magnetic field in products such as loudspeakers. Magnetic materials such as alnico demagnetize and remagnetize easily, so care must be taken in the design of magnetic structures using alnico so that the magnetic source is protected from adverse magnetic fields like those produced by voice coils. Materials such as ferrites are innately difficult to magnetize and demagnetize, allowing more freedom in the design of magnetic structures without the same regard to adverse fields.

- I -

IEC
International Electrotechnical Commission. Also, the tape playback and record equalization standard specified by the IEC and used on many european analog tape recorders.

IEEE
Institute of Electrical and Electronic Engineers.

IHF
Institute of High Fidelity.

IM
Intermodulation Distortion. A form of distortion caused by two or more audio signal components that beat against each other to produce non-harmonically related pitches which do not sound musical because they are not part of tones or chords present in the original signal.

IMPEDANCE
The total amount of opposition to the flow of alternating currents in an electrical circuit which may comprise resistance, capacitance, inductance or reactance. Reactance is the imaginary part of impedance in the case where current and voltage are not in phase in an A.C. circuit due to the circuit's components and the frequency of the signal feeding through them. In such a case the impedance may be negative.

IMPEDANCE, load
The input impedance encountered by incoming signals from an audio circuit. The impedance presented by the load to a source or network.

IMPEDANCE, matching
The use of inputs and outputs whose impedance is equal, taking into account the effects of total circuit reactance on signals passing from output to input in order to produce minimum phase shift, optimum frequency response and optimum power transfer characteristics in the circuit. The DIN (Deutche Industrie Normen) standard adopted in West Germany, calls for all devices to have input impedances 100 times larger than the output impedances of devices driving them, specifically, 100 ohms output driving 10,000 ohms input impedance. The logic involved is that sufficiently low output or source impedances are "stiff" enough to swamp out impedance effects in subsequent circuits—to prevent the tail-wagging-the-dog symptom inherent in systems for which impedance matching is the only other solution.

IMPEDANCE, source
That output impedance which, when shunted by a resistor whose value in ohms is equal to it, loses half its original output voltage. The output impedance of most modern circuits such as solid-state amplifiers, chip or IC amplifiers and so on is nearly pure resistance because their circuitry is followed by buildout resistors to protect their solid state components thus allowing circuit design based on source resistance without regard to reactive impedance effects at the outputs of electronic devices. Power amplifiers, on the other hand, generally have very low source resistance and impedance. (see DAMPING)

INDUCTANCE
The term used to describe the electrical property of an inductor (coil or choke) in units of henrys (H), millihenrys (mH), microhenrys (μH), etc. A mechanical analogy of an inductor is an electrical spring; the inductor can store electrical energy fed into it and return it directly back into the circuit. The inductor tends to block the flow of A.C. currents depending on their frequency, and pass D.C. currents through.

INFINITE BAFFLE
A loudspeaker baffle that prevents the loudspeaker's rear radiation from entering the environment where the front radiation is being used. An infinite baffle may consist of either a wall extending out from the mounting surface of the loudspeaker such as when the loudspeaker is mounted in a hole cut in a wall, or a sealed enclosure filled with highly absorbent material such as fiberglass, for the purpose of soaking up the rear radiation.

INFRASONIC
Sound at frequencies generally considered to low to be heard (sounds in the range of 1 hertz to 15 hertz). Infrasonic sound can be felt if its power level is sufficiently high, and can cause nervousness and/or fatigue and disorientation in people exposed to it.

INPUT LEVEL
The level in units such as dB, volts or watts that a particular piece of electronic equipment receives at its input. Input levels are alternately described as nominal (the normal operating level) or maximum (the level above which distortion occurs). As an example, a piece of gear might have a meter marked " VU " and its specifications might say "nominal input: +4 dBu (1.228 volt), maximum input: +24 dBu (12.28 volts)." Feeding this piece of gear a 1.228 volt input signal should cause its meter to indicate 0 dB, and increasing the input voltage to 4 volts should make the meter indicate +10.2 dB when the unit's level controls are set to unity gain (see dB conversion table on page 7).

INSERTION LOSS
The loss in signal amplitude associated with passive electrical devices or circuit elements such as transformers, autoformers or passive high-level loudspeaker crossovers, that are inserted into the signal path of an electrical or electroacoustical system.

ISOLATION, acoustic
Refers to the attenuation of sound in adjacent acoustical spaces such as the isolation of the recording studio and control room by means of heavy double doors with air spaces and triple plate glass windows. The term is also applied to circuits in equipment such as mixers, in which isolation means the opposite of crosstalk.

- J -

JAN
Joint Army-Navy specification. Pertains to the stringent government specifications used for electronic components of specified quality or survivability or of tightly maintained quality control, and often means these parts will last longer, withstand higher temperatures, voltages, currents, etc., than their consumer counterparts.

JOULE
The joule is the work done when the point of application of 1 newton of force is displaced a distance of 1 meter in the direction of the force.

JUNCTION BOX
A box that provides cable terminations at jacks or connectors such as the XL-type microphone connections at the end of a multi-conductor microphone cable or "snake."

- K -

kHz
SI units abbreviation for kilohertz. One thousand cycles per second, or the repetition of an event, vibration or oscillation at a rate of one thousand per second. The term kHz replaces the obsoleted term kc (kilocycles).

KILO-
The standard SI prefix for thousands. The prefix kilo must always be spelled and abbreviated in lower case lettering. See SI for more information on standard units and prefixes and their use.

- L -

LCD
Liquid Crystal Display. Display composed of mobile crystals in liquid suspension, which align themselves and polarize light in response to a small electric change. The crystals are manufactured in pockets within the display which correspond to areas of dark on light background.

LEAKAGE
The unwanted pickup of stray sound from sources other than the intended source feeding a specific microphone channel.

LED
Light Emitting Diode. A solid-state diode rectifier whose atomic properties cause it to emit light when electric current is passed through it. Current LED technology allows the emission of light from infrared through green frequencies, and visible light LEDs are available in colors from deep red to green.

LEDE
Live End, Dead End. A listening room design technique used primarily in recording studio control rooms, where absorptive material is placed near the loudspeakers and reflective material is placed behind the listener.

LEVEL
The amount of power present at some point in an audio system. Specifically, the term level refers to the power magnitude in either electrical watts or acoustic watts but is often incorrectly used to denote voltage. (see also POWER and SPL)

LEVELING AMPLIFIER
An alternate term for "compressor" or "limiter."

LIMITER
An audio amplifier whose output amplification rate of change is less than its input signal amplitude rate of change. While compressors are used to reduce the dynamic range of program signal either to make everything sound louder, or to automatically control sudden large changes in signal amplitude such as in the case of recording vocalists, limiters are used to prevent dynamic transient signal peaks from exceeding a pre set amplitude. Limiters are usually required when broadcast signals are fed to telephone lines, and are useful to prevent power amplifier clipping and overdriving in large sound systems. Limiters sometimes include circuits that allow the user to adjust the time it takes to start reducing the signal amplitude (attack), to ease up on the compression (release), and also the input and output gain. (see also, COMPRESSOR)

LINEAR
When the output of a device tracks its input accurately, it is said to be linear. In the case of audio equipment, the output would be directly proportional to the input.

LINE LEVEL
The average (power) level at which signal-carrying wires operate. In audio systems, operating "levels" are usually divided into three categories.

Mic level:	-90 dBm (one picowatt) to -30 dBm (one microwatt).
Line level:	-30 dBm (one microwatt) to +30 dBm (one watt).
Speaker level:	line level or higher (audible from loudspeaker).

Typical levels that might correspond to a "0 VU" meter reading for these three categories are 2.45 millivolts (-50 dBu) for microphones, 316 millivolts (-10 dBV) or 1.23 volts (+4 dBu) for mixers, tape decks and signal processing equipment, and up to 70.7 volts (+37 dBV) for loudspeakers.

LINE OUT or LINE OUTPUT
An audio equipment output that supplies signals whose average magnitude is line level, between about 10 millivolts and 25 volts.

LINE RADIATOR
Usually, a speaker system in the form of a column of similar individual loudspeakers. Column speakers exhibit the same horizontal dispersion as a single loudspeaker element within the column, but narrower vertical dispersion due to sound wavelengths and the vertical dimension of the column. (see WAVELENGTH)

LOUDNESS
Sound volume as it is detected by the average human ear. Hearing is non-flat, and this non-flatness varies with changes in absolute SPL (Sound Pressure Level). The chart on page 14 shows curves of equal loudness for various absolute SPLs.

LOUDSPEAKER
A device for making audible sound waves, typically, an electroacoustic transducer that converts alternating current electrical oscillations fed to it, into acoustic oscillations (sound). The term "driver" is often used to denote individual loudspeakers within a speaker system, while the term "speaker" is often used to refer to the entire system comprising driver(s), enclosure and crossover.

LOW CUT
(see HIGH PASS)

LOW PASS
A circuit or filter that stops high frequencies and passes low frequencies. A typical low pass filter use is the hiss or scratch filter found on many preamplifiers or receivers to reduce static or record scratch noise, which is predominantly high frequency noise the ear is quite sensitive to. Low pass filters are used to attenuate or eliminate high frequencies from the drive to woofers so that they can operate in the frequency range where they are most linear.

- M -

MASKING
Masking is sound applied to an engineered environment to provide privacy in open office areas. The term "masking" refers to the so-called "cocktail-party effect" where certain conversations are hard to pick out because similar sounds mask them. The ear-brain can be fooled into not hearing certain sounds if other sounds at lower volume but sufficient complexity are simultaneously present. Pink noise is most often used to cause intentional masking; its spectrum is shaped or filtered and fed to loudspeakers hidden above an acoustical tile ceiling.

MICROBAR
A deprecated term for one millionth of a bar, the unit of atmospheric pressure replaced by the SI unit, the pascal (Pa). Atmospheric pressure at sea level reads 1,010,300 microbars, 101.3 kPa (kilopascals), or 101,300 pascals. In terms of sound pressure level, the pascal represents 94 decibels, and the microbar represents 74 decibels. (see PASCAL, see also SPL chart on last page)

MICROPHONE
An electroacoustic transducer which produces alternating current electrical signals proportional to sound signals to which it is exposed. Microphones are usually grouped into categories according to their directional sensitivity characteristics, their means of producing electrical signals, or the type of sound field they respond to i.e., some microphones respond to changes in air particle density (pressure microphones) and some to air particle motion (velocity microphones). Combinations of pressure, velocity or phase sensitivity can be employed in the design of microphones to yield nearly any desired pickup pattern.

MONAURAL
Having one ear. Monaural headsets (with a single earpiece) are typically used by telephone operators, stage managers and disco operators.

MONITOR
A device used as a reference for determining the integrity or quality of original program signals. Television monitors seldom have tuners or other extras, are adjusted for neutral color rendition (true color) and must have bandwidth (resolution) capabilities greater than the signals they are intended to display. Monitor speakers, like video monitors, should exhibit bandwidth that extends beyond the intended signal bandwidth, should be free of sound coloration and should have adequate resolution (accuracy) to make any faults such as ticks or hum audible to the operator. The dynamic range of both our eyes and ears, far exceed the capabilities of monitor devices to display or produce accurate facsimiles of life, so monitor use should include thoughtful adjustment of dynamics to make visual or sound images fit the capabilities of the monitor. These take the form of volume

level adjustment for monitor speakers and brightness and contrast range adjustment for video monitors.

MONOPHONIC or MONO
Sound from one source, such as a single loudspeaker or earphone.

MULTI-MICROPHONE MONO
As used in multitrack recording of popular music, single microphone mono sounds are recorded onto various tape channels and then mixed together, using pan pots to adjust the left-to-right panoramic image position of each channel to create an impression of stereo sound when the final two-channel (stereo) program product is heard through headphones or stereo speakers.

MYLAR
Registered trade name of a particular polyester plastic manufactured by E.I. DuPont DeNemours Chemicals, Inc. Some of the many uses of Mylar include backing for recording tape, winding film for electric capacitors, and professional-use drum heads.

- N -

NAB
National Association of Broadcasters.

NANO-
The internationally used (SI) unit prefix designating divide by one billion or multiply by one billionth (10^{-9} or 1/1,000,000,000). The nano prefix is always written in lower case and always abbreviated simply by the letter n. Such prefixes are written with units such as meters (nm) or watts (nW) with no space between prefix and unit, but a single space after the numerical descriptor. The terms "250 nanowebers per meter" would therefore be written, 250 nWb/m.

NANOWEBER
One billionth (10^{-9} or 0.000000001) of a weber. The weber is the SI unit of magnetic flux. (see WEBER)

NEWTON
The newton is that force which gives to a mass of 1 kilogram an acceleration of 1 meter per second per second.

NOISE
Any unstructured and generally unwanted signal. Hum, buzz, hiss, crosstalk and rumble are typically classed as noise.

Random noise, as the name suggests, is noise consisting of random frequencies with random time and amplitude characteristics.

White noise is random noise whose various frequency components all share the same energy density characteristics, producing the same voltage at any particular discrete frequency over a period of time, thus causing a frequency response trend that rises the same number of decibels as the percentage of frequency increase. The 10 dB per decade of frequency (ten times power for ten times frequency) or 3 dB per octave of frequency (doubling of power for a doubling of frequency) is indicative of how many more discrete frequencies are crammed together in the same percentage of bandwidth spacing as frequency rises.

Pink noise is filtered white noise that exhibits a constant power in any band of frequencies of the same span percentage. For example the octave between 20 and 40 hertz contains only 20 hertz, while the octave between 2000 and 4000 hertz contains 2000 hertz. These two bands exhibit the same pink noise power, while the 2000–4000 hertz band would exhibit 100 times as much power if it were simply unfiltered white noise. Pink noise is used extensively as an audio measurement signal source because of its uniform power-per-bandwidth characteristic, and it has been suggested that music source material, averaged over a long time period, is roughly equivalent to pink noise in spectral energy distribution.

NOISE FLOOR
The intrinsic noise of an electronic device or system. The noise that remains in the absence of signal.

NOISE GATE
A circuit that attenuates or shuts off audio signals that fall below a threshold, usually set by the user. Noise gates are used to eliminate background hiss in sound systems and motion picture soundtrack restoration or low-level microphone leakage in multitrack, multi-microphone recording, etc.

NOMINAL OPERATING LEVEL
The design target signal level of audio circuits. For example, a crossover may have a noise floor of -80 dBu and a maximum output voltage of +24 dBu and call for a nominal operating level of +4 dBu which means that the nominal signal level will be 84 dB higher than the noise and allow for 20 dB of headroom.

- O -

OCTAVE
A doubling or halving of frequency. The numerical interval, for example, between 440 Hz and 880 Hz or 220 Hz is an octave.

OFF AXIS
(see AXIS, see POLAR PATTERN or POLAR RESPONSE)

OHM
The ohm is the electric resistance between two points of a conductor when a constant difference of potential of 1 volt, applied between these two points, produces in this conductor a current of 1 ampere, this conductor not being the source of any electromotive force.

OHM'S LAW
Physicist Georg Simon Ohm (1789– 1854) described the relationship between electric current and resistance. Ohm's law states that the steady current through certain electrical circuits is directly proportional to the applied electromotive force, or, I=E/R where I is current, E is voltage and R is resistance. Equations solving for volts amperes and watts are derived from Ohm's basic equation. When calculating these quantities for A.C. circuits, the phase angle of the currents in the circuit must also be considered.

OMNI-DIRECTIONAL
Every direction. Omni-directional loudspeakers direct sound equally at all angles. Omni-directional microphones have equal sensitivity to sound coming from any angle.

OSCILLATOR
A device that oscillates. Sound is the oscillation of air caused by a mechanical oscillation such as that from a moving piano string or drum head. An electronic oscillator is a device containing circuits designed to produce electrical oscillations that are maintained, usually at a constant amplitude, and may have other specific characteristics, that suit them for use as circuit test signals.

OSCILLOSCOPE
An electronic test instrument which produces a visible image of electrical signals such as oscillations or waveforms, on a viewing screen.

OVERLOAD
The condition in which equipment is stressed beyond its normal operating limits. For sound equipment, overload may take the form of clipping in circuits, overheating of amplifiers, burning of loudspeaker voice coils, or loss of circuit integrity or breakdown. Overload may also be thought of as system operation at levels higher than the levels at which operation is linear, the overload condition producing non-linear circuit or system behavior, such as distortion. (see DISTORTION)

- P -

PAN or PAN POT
A two-circuit volume control used to place the auditory image of a sound from a mixer channel between the left and right speakers.

PASCAL
The SI unit of pressure, abbreviated Pa and defined as a pressure of 1 newton per square meter. In terms of sound it is convenient to imagine air in a balloon where the pressure is equal on the inside surface. An air pressure oscillation of one pascal R.M.S. produces a sound pressure level of 94 decibels referred to the threshold of hearing at 20 micropascals (20 μPa), and is roughly equivalent to 2.2 watts per square meter or about 100 nanowatts (10^{-9} or 0.0000001 watt) of acoustic power on human eardrums.

PASSBAND
The range of frequencies, within the -3 dB limits at the ends of the range. The "audio passband," for example, of a loudspeaker, would be the loudspeaker's frequency range within its -3 dB lower and upper frequency limits.

PASSIVE NETWORK
(see CROSSOVER)

PASSIVE RADIATOR
The passive radiator or "drone cone" is a movable mass, suspended over an opening in a speaker enclosure where it is free to resonate. The principle of operation of the passive radiator is a simple substitute for an air mass in a duct that would otherwise be too large to fit into the enclosure.

PHASE PLUG
An acoustical transformer and filter consisting of a mechanical channel or set of channels that guide sound from the moving diaphragm of a compression loudspeaker, to the exit throat of the loudspeaker. The phase plug is designed to match the diaphragm's acoustical impedance to that of a horn, and to adjust the sound path length from various areas of the diaphragm to the exit throat to maintain uniform phase. Generally, the more nearly equal are the sound paths through the phase plug from diaphragm to throat, the better the high-frequency response of the loudspeaker.

PINK NOISE
(see NOISE)

POLAR PATTERN or POLAR RESPONSE
The magnitude of output as a function of off-axis angle for speakers, or the sensitivity as a function of off-axis angle for microphones. Typically, the device (microphone or speaker) is "normalized" on-axis, that is, the on-axis

level is regarded as the 0 db reference and all measurements made off-axis then produce negative dB numbers. A horn said to have a polar pattern of 90 degrees, therefore, is one whose output level is -6 dB referred to its on-axis level, when measured 45 degrees off-axis.

POWER
Power is the conversion of energy to work. The unit of power is the watt (W). When complex signals such as music (time and voltage varying) are measured, a value for watts is derived by the use of R.M.S. (Root Mean Square) voltage divided by the load impedance to describe the amount of energy.

POWER BANDWIDTH
The frequency range over which a power amplifier can produce at least half power (-3 dB). This important specification is the actual indication of an amplifier's true power output capability, since many amplifiers are capable of much higher power outputs if frequency extremes such as those produced by music are ignored.

POWER RESPONSE
Like frequency response, power response is a measure of a loudspeaker's output with reference to its electrical input. Power response, however, includes the total sound energy radiated into the acoustic space around the loudspeaker rather than just on-axis. Flat power response, therefore, would indicate that a loudspeaker is radiating equal energy into all angles at all frequencies.

- Q -

Q
The term "Q" refers to the width of an effect. For example, a filter's Q is a measure of the frequency of the filter divided by the number of hertz contained within the band of frequencies bounded by the -3 dB points, thus an EQ filter at 1 kHz with a Q of 2 is 500 hertz wide at the -3 dB points. The Q factor of a horn is a measure of what part of a spherical pattern the horn radiates into (the beamwidth), therefore, where an omnidirectional source has a Q of 1 and the source placed on a reflecting surface has a Q of 2, a horn whose pattern is 90 by 90 degrees (one-eighth of a sphere), would have a Q of 8.

QUARTER SPACE
One quarter of a sphere. An acoustic boundary condition where two surfaces of a room cause low-frequency radiation from a speaker to be folded onto itself twice; once from each surface, producing a 6 dB increase in sound pressure over what the source would measure if hung in free space away from reflecting surfaces.

- R -

REACTANCE
The electrical characteristic of inductors and of capacitors, opposing the flow of A.C. electricity. Reactance is measured in ohms and may be negative, producing what is called an "imaginary" part of an impedance. Loudspeakers, for example, can be highly reactive, and under certain circumstances with certain signals, can feed 50 amperes or more back into the power amplifier driving them.

REFLECTION
Like light from a mirror, sound bouncing from a wall or other surface reflects. The amount and angle of sound reflection depends on the type and size of the reflecting surface, and the frequency (wavelength) of the sound.

REFLEX ENCLOSURE
A loudspeaker enclosure which uses the resonance of its internal air volume to assist the loudspeaker's motion, reducing distortion at low frequencies and extending low-frequency bandwidth.

REFRACTION
The bending of waves. Sound waves bend when they encounter boundary edges or air of a different temperature.

REMANENCE
The magnetic flux remaining in a magnetized material after a saturating magnetic field is applied and then removed.

RESISTANCE
Resistance to the flow of electric current. (see OHM)

RESISTOR
An electrical component made to resist current flow.

RESONANCE
The natural vibration or oscillation of mechanical or electrical systems at specific frequencies that depend on qualities such as mass and springiness (mechanical systems) or capacitance and inductance (electrical systems).

REVERBERATION TIME (RT_{60})
The time it takes for all reflected sounds in a space to decay 60 dB after the exciting sound source is turned off.

- S -

SABIN
The unit of acoustical absorption, named after Wallace Sabine. The sabin is the total absorbtion of sound by a surface area of one square foot.

SENSITIVITY

For mixers and amplifiers, sensitivity refers to the amount of input required to drive the circuit to its rated output.

For loudspeakers, sensitivity refers to the sound pressure produced by a given input voltage or power.

For microphones, sensitivity refers to the amount of electrical output produced by incident sound at a given sound pressure.

SI UNITS

The SI units are used to derive units of measurement for all physical quantities and phenomena. There are seven basic SI "base units," these are:

NAME	SYMBOL	QUANTITY
ampere	A	electric current
candela	cd	luminous intensity
meter	m	length
kelvin	K	thermodynamic temperature
kilogram	kg	mass
mole	mol	amount of substance
second	s	time

The SI derived units and supplementary units are listed here with applicable derivative equations:

NAME	SYMBOL	QUANTITY	DERIVED BY:
coulomb	C	quantity of electricity	A·s
farad	F	capacitance	A·s/V
henry	H	inductance	V·s/A
hertz	Hz	frequency	s^{-}
joule	J	energy or work	N·m
lumen	lm	luminous flux	cd·sr
lux	lx	illuminance	lm/m^2
newton	N	force	$kg·m/s^2$
ohm	Ω	electric resistance	V/A
pascal	Pa	pressure	N/m^2
radian	rad	plane angle	
steradian	sr	solid angle	
tesla	T	magnetic flux density	Wb/m^2
volt	V	potential difference	W/A
watt	W	power	J/s
weber	Wb	magnetic flux	V·s

FURTHER DERIVED UNITS:

NAME	SYMBOL	QUANTITY
ampere per meter	A/m	magnetic field strength
candela per square meter	cd/m^2	luminance
joule per kelvin	J/K	entropy
joule per kilogram kelvin	J/(kg-K)	specific heat capacity
kilogram per cubic meter	kg/m^3	mass density (density)
meter per second	m/s	speed, velocity
meter per second per second	m/s^2	acceleration
square meter	m^2	area
cubic meter	m^3	volume
square meter per second	m^2/s	kinematic viscosity
newton-second per square meter	$N\text{-}s/m^2$	dynamic viscosity
1 per second	s^{-}	radioactivity
radian per second	rad/s	angular velocity
radian per second per second	rad/s^2	angular acceleration
volt per meter	V/m	electric field strength
watt per meter kelvin	W/(m·K)	thermal conductivity
watt per steradian	W/sr	radiant intensity

DEFINITIONS OF SI UNITS

The **ampere** is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to $2X10^{-7}$ newton per meter of length.

The **candela** is the luminous intensity, in the perpendicular direction, of a surface of 1/600,000 square meter of a blackbody at the temperature of freezing platinum under a pressure of 101,325 newtons per square meter.

The **coulomb** is the quantity of electricity transported in 1 second by the current of 1 ampere.

The **farad** is the capacitance of a capacitor between the plates of which there appears a difference of potential of 1 volt when it is charged by a quantity of electricity equal to 1 coulomb.

The **henry** is the inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 ampere per second.

The **joule** is the work done when the point of application of 1 newton is displaced a distance of 1 meter in the direction of the force.

The **kelvin**, the unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

The **kilogram** is the unit of mass; it is equal to the mass of the international prototype of the kilogram. (The international prototype of the kilogram is a particular cylinder of platinum-iridium alloy which is preserved in a vault at Sevres, France, by the International Bureau of Weights and Measures.)

The **lumen** is the luminous flux emitted in a solid angle of 1 steradian by a uniform point source having an intensity of 1 candela.

The **meter** is the length equal to 1,650,763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the krypton-86 atom.

The **mole** is the amount of substance of a system which contains as many elementary entities as there are carbon atoms in 12 grams of carbon 12. The elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles or specified groups of such particles.

The **newton** is that force which gives to a mass of 1 kilogram an acceleration of 1 meter per second per second.

The **ohm** is the electric resistance between two points of a conductor when a constant difference of potential of 1 volt, applied between these two points, produces in this conductor a current of 1 ampere, this conductor not being the source of any electromotive force.

The **radian** is the plane angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius.

The **second** is the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom.

The **steradian** is the solid angle which, having its vertex in the center of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

The **volt** is the difference of electric potential between two points of a conducting wire carrying a constant current of 1 ampere, when the power dissipated between these points is equal to 1 watt.
The **watt** is the power which gives rise to the production of energy at the rate of 1 joule per second.

The **weber** is the magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of 1 volt as it is reduced to zero at a uniform rate in 1 second.

The **liter**, although not an SI derived unit, is used extensively to denote volume. Officially, the liter (l) is 1/1000 of a cubic meter.

SI PREFIXES

The names of multiples and submultiples of any SI unit are formed by application of the prefixes:

MULTIPLIER	PREFIX	SYMBOL	TIMES 1, IS EQUAL TO:
10^{18}	exa	E	1 000 000 000 000 000 000
10^{15}	peta	P	1 000 000 000 000 000
10^{12}	tera	T	1 000 000 000 000
10^{9}	giga	G	1 000 000 000
10^{6}	mega	M	1 000 000
10^{3}	kilo	k	1 000
10^{2}	hecto	h	100
10	deka	da	10
0	--	--	1 (unity)
10^{-1}	deci	d	.1
10^{-2}	centi	c	.01
10^{-3}	milli	m	.001
10^{-6}	micro	μ	.000 001
10^{-9}	nano	n	.000 000 001
10^{-12}	pico	p	.000 000 000 001
10^{-15}	femto	f	.000 000 000 000 001
10^{-18}	atto	a	.000 000 000 000 000 001

Some examples: ten-thousand grams is written: 10 kg, 20,000 cycles per second is written: 20 kHz, 10-million hertz is written: 10 MHz, and 250 billionths of a weber per meter of magnetic flux is written: 250 nWb/m.

Always use less than 1000 units with an SI prefix: "1000 MGS" is advertising hyperbole and should be written " 1 g " only.
SI prefixes and units should be written together and then set off by a space (single space in print) from their numerators. For example; use the form "35 mm " instead of " 35mm " and " 1 kHz " instead of " 1k Hz ."

When writing use standard SI formats and be consistent. You should consult National Bureau of Standards publication 330, (1977) for details on usage.

Never combine SI prefixes directly, that is, write 10^{-10} farads as 100 pF instead of 0.1 micro-microfarads (μμF). Keep in mind that whenever you write out a unit name longhand, the rule is that the name is all lower case, but when abbreviating, the first letter is upper case if the unit is named after a person and lower case if it is not; examples: V = volt for Volta, F = farad for Faraday, T = tesla for Tesla, and so on. Letter m = meter, s = second, rad = radian, l = liter and so on. Revolutions per minute may be written only

as r/min. miles per hour may be written only as mi./hr.. and inches per second may be written only as in./s and so on.

In addition to the correct upper and lower case, prefixes and combinations, there is also a conventional text spacing for SI units and abbreviations. Write 20 Hz, rather than 20Hz. Write 20 kHz, rather than 20k Hz, and so on. Always separate the numerator of a unit from its prefix and/or unit name, but do not separate the prefix and name. -dd

SUBSONIC
Below the speed of sound. (see also, INFRASONIC)

SUBWOOFER
Loudspeaker system designed to produce or reproduce only low frequency sounds, typically below 150 hertz.

SUPERSONIC
Faster than the speed of sound (approximately 344 meters or 1130 feet per second at sea level). (see ULTRASONIC)

- T -

TESLA
The SI unit of magnetic flux density, derived by webers per square meter.

THIELE or THIELE-SMALL ALIGNMENT
The use of mathematical simulation of speaker system low frequency operation by calculating the values of the electrical analogies of loudspeakers and enclosures.

TIMBRE
Characteristic sound. Timbre is formed and affected by the ratios of harmonics to their fundamental, allowing for the difference heard in the same pitch played on different instruments.

TIME DELAY SPECTROMETRY
Time Delay Spectrometry is a method of measuring audio signals by creating a measurement "time window" through which signals pass without concomitant obscuring noise.

TRANSDUCER
A device which converts one form of energy directly into to another form of energy. Loudspeakers, microphones and motors are transducers which convert motion into electricity or vice versa. Light-emitting diodes and solar cells are transducers that convert electricity to light or vice versa, etc.

TRANSFORMER
A device used to isolate or to raise or lower an A.C. voltage from its input to its output. A typical transformer may consist of two separate coils of wire wound on a magnetic steel core. When an A.C. current passes through the input coil (primary) it produces an alternating magnetic field in the core, which in turn produces current flow in the output coil (secondary). By winding a greater number of coil turns for the secondary winding, the input voltage is raised at the output; by using fewer secondary turns, the output voltage is lowered. An isolation transformer uses the same number of turns for primary and secondary, maintaining the same input voltage at the output while severing the electrical connection of the two coil windings.

TRANSIENT
A momentary amplitude peak in program source. A pop from a switch or scratched record may form signal transients. Musical transients occur as a result of such things as percussion instruments, piano and guitar. Normal musical transients my have amplitude peaks as high as 40 dB above the average program levels, requiring headroom in the circuits and equipment used to reproduce them.

TRANSIENT RESPONSE
The response of audio equipment to sudden large changes in signal amplitude, such as those produced by musical transients.

TUNED ENCLOSURE
A speaker enclosure designed to use its internal air volume to aid operation of a woofer installed in it. Reflex or bass-reflex enclosures are one form of tuned enclosures. Tuned pipe enclosures use their internal air volume as a resonating air column like an organ pipe, driven by the woofer.

TUNED PORT
The vent in a reflex enclosure which causes the air inside the enclosure to resonate at a particular frequency, obtained by adjusting the vent opening size. When ducts (tubes or tunnels) are added to vent openings, the tuned frequency is lowered, allowing the use of larger vent area openings to achieve the same tuning frequency.

TWEETER
A loudspeaker designed to reproduce high frequencies only. Tweeters are typically used at frequencies beyond the center of the audio spectrum, which, if placed on a logarithmic scale like a piano keyboard, would be about 630 Hz.

- U -

ULTRASONIC
Beyond the range of human hearing. (see SUPERSONIC)

UNBALANCED
Wiring consisting of two conductors, usually one inside the other with the outer conductor shielding the inner conductor. The outer shield is connected to ground or chassis and the inner conductor carries the signal. Virtually all hi-fi signal wiring is of the unbalanced type, as is wiring inside TV sets, audio mixers and other audio equipment. (see FLOATING)

UNITY GAIN
No gain or loss. A device with unity gain would produce the same voltage at its output as the voltage applied at its input.

- V -

VA
Volt-Ampere. Like watts, VA is used to describe the product of volts multiplied by amperes, but in circuits that exhibit reactance.

VCA
Voltage Controlled Amplifier. An amplifier whose gain can be controlled by varying an external D.C. voltage. Since this D.C. voltage is relatively simple for computers to provide, the inclusion of VCAs in mixers and mixing consoles simplifies remote control of volume levels or memorized mixing functions.

VOICE COIL
A coil of wire within a magnetic field in a loudspeaker, which produces magnetic fields in response to signals from audio power amplifiers. These fields cause the voice coil to move within the stationary magnetic field of the loudspeaker, moving the diaphragm attached to it and the air touching the diaphragm.

VOICING
The equalization of sounds produced by a system such as a piano or a loudspeaker so that the audio spectrum is produced evenly with all notes or frequencies at the same volume.

VOLUME
A popular term used to denote sound intensity level.

- W -

WATT
The watt is the power which gives rise to the production of energy at the rate of 1 joule per second. (see JOULE)

WAVELENGTH
The length of waves (from crest through trough to crest) produced by propagating sound, light or electromagnetic radiation. All radiation produces waves. Sound is the slowest propagating wave, traveling approximately 344 meters or 1130 feet per second. Thus sound waves produced by a 1000 Hz tone are about 0.344 m or 1.13 foot in length (1000 per second divided by 1000 = one cycle = one wavelength). Light and electromagnetic radiation in the vacuum of space travel at 299,792.4563 kilometers or about 186,282 miles per second. Visible light waves are on the order of 450 to 700 nanometers or 17 to 28 trillionths ($28X10^{-12}$ or 0.000000000028) of an inch in length.

WAVEFORM
The shape of the wave produced by a sound. Such shapes depend on the content of harmonics of the sound, and can be viewed on an oscilloscope fed by a microphone or other sound signal source.

WEBER
The weber is the SI unit of magnetic flux. The weber is abbreviated with upper case W, lower case b (Wb). The concept of flux can be tricky to state. The International General Conference on Weights and Measures used the following wording to define the weber: The weber is the magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of 1 volt as it is reduced to zero at a uniform rate in 1 second.

WET
The addition of reverberation to audio program source material makes the sound "wet" referred to "dry" sounds with no reverberation. (see DRY)

WHITE NOISE
(see NOISE)

WOOFER
A loudspeaker designed to reproduce low-frequency sound only. Some woofers are called full-range loudspeakers and are used alone e.g. ceiling speakers. Woofers in systems are usually used below about 3000 Hz.

- X -

XFMR
An abbreviation for "transformer."

XL or XLR CONNECTOR
Typically, a three-pin plug or receptacle with a metal shell, used for microphone cables and line level signal-carrying cabling.