F

F1: See *PCM-F1*.

fade: (1) Slow alteration of the level of a signal, usually using a *potentiometer*. See *fade-in/fade-out*. (2) Of a piece of music, usually commercial music, the repeated section at the end of the song which is subjected to a gradual fade-out. See also *outro*. (3) Short for fade-in/fade-out. Optical effects in which a scene is printed with exposure increasing or decreasing to blackness for fade-in and fade-out, respectively.

fader: (1) A variable *attenuator*, or volume control. (2) A variable control used to change the distribution of power between front and rear speakers.

fade-in/fade-out: A feature of most audio editing software that allows the user to apply gradual *amplitude* increase or decrease over some segment of the sound. Fade-in starts with no signal and gradually increases the level. Fade-out starts with a signal present and gradually decreases the level, normally to silence. See *crossfade*.

far-field: If a sound source is operating in an enclosed space, the SPL will vary with the distance that the measuring microphone is from the source. At certain close ranges, the levels will obey the *inverse square law* and at these distances, there will exist approximately a *free-field*. At greater distances, the reduction in measured level with increased distance will be less than predicted by the inverse square, and finally a region will be reached where the level is almost constant regardless of the distance, and this is called the *reverberant field*. The area between the free-field and the reverberant field is called the far-field. Its extent is a characteristic of the directionality of the sound source as well as of the acoustics of the room.

FASA: Frequency, Amplitude, Spectrum, and Ambience. An audio production method which is based on the criteria that can be changed in sonic terms to enhance a recording:

> **Frequency**: Pitch, transposing parts, chord inversions, layering with other octaves.

> **Amplitude**: Level, use of dynamic range to cut and boost sections, and relative volumes among parts.

> **Spectrum**: Textures and the range of frequencies present, layering sounds with others, introducing new textures from other parts, changing the sounds for a part, like playing a percussion line as a bass part, the contrast in frequency and textures used.

> **Ambience**: Space, reverb, and image information such as panning, depth, height, forward or recessed, for each part playing.

Faulkner array: A *near-coincident* microphone configuration which uses a pair of *figure-eight* microphones, both facing directly forward, but separated by about 8".

feed: In signal routing, an output from one device that is sent into another.

feedback: There are two types of audio feedback: acoustic and electronic. (1) Acoustic feedback is where a gain control is set too high in a sound reinforcement system and the amplified sound enters the microphone and is reamplified until a steady howl or whistle is heard. This is also called *regeneration*. (2) Electronic feedback (or *negative feedback*) involves the application of a small portion of the output voltage of an amplifier to the input so as to cancel part of the input signal, reducing the gain of the amplifier, but also reducing the distortion and noise introduced by the amplifier. See *bootstrap*. (3) A specific application of feedback in *FM synthesis*, where at least one operator in each algorithm is equipped with a feedback loop.

F

feed reel: The input reel on a tape recorder, from which audio or video tape is fed to the *head stack* and onto the *take-up reel*.

feet/frames: Footage numbers for film, either separated by a colon or by a "plus" sign. For example, 101:16 and 0101+16 both indicate a point 101 feet and 16 *frames* into the film. There are 16 frames per foot of 35mm film, and 40 frames per foot of 16mm film. See *SMPTE time-code, LFOP, ABS*.

FFT analyzer: A digital device which performs the transformation from the time domain to the frequency domain of a sound *spectrum* over a wide frequency range and dynamic range. It is used to measure *distortion, S/N ratio, flutter* and *wow*, as well as the *phase* response and *frequency response* of audio devices. See *Fourier analysis*.

fidelity: The accuracy with which a music reproduction system will recreate the sound of the original music.

field: (1) The subjective environment which a listener perceives while listening to sound, such as a stereo field. See *stereophonic, ambisonic*. (2) The area around one or more microphones; the *acceptance angle* of the microphone. (3) The spatial area of *electromagnetic* force. (4) In video, a subgroup of visual data consisting of either the odd- or even-numbered lines of any *frame*. In NTSC, for example, each field is displayed separately for $\frac{1}{60}$ of a second within the total frame duration of $\frac{1}{30}$ second. For each frame, field number one contains line #1, #3...#525; field number two contains lines #2, #4...#524. PAL television broadcasts use an analogous scheme, but has a different frame rate and number of lines per frame. See *blanking interval*.

field rate: Frequency at which video fields occur: 59.94Hz in NTSC, 50Hz in PAL.

fifth: The interval between a note and the one seven half-steps above or below it. See *interval*.

figure-eight microphone: A *directional microphone* whose pick-up pattern resembles the figure 8, meaning that it is insensitive to the sides but has full sensitivity at the front and back. As the polar pattern resembles the shape of a cosine curve, the figure-eight microphone is sometimes also called a *cosine microphone*. Figure-eight mics were traditionally *ribbon mics*, but now they can also be *condenser mics*. Also called a *bi-directional microphone*.

file format: The data in a computer file has a particular order and length. The specification which determines the structure of the file is called the file format and is software- and/or hardware-specific. Files, such as MIDI files, may contain data, instructions to other software programs and/or hardware devices, and/or programs. The file may also contain ECC data, network information, and other non-user overhead data. Some file formats are made publicly available to allow the implementation of *plug-ins*; others are proprietary to the vendor. The file format usually begins with a file header, followed by data, followed by *ECC* data, followed by some kind of *stop bit*, if the file format is variable-length. See *AIFF, RIFF, .AU, MPEG, .MOD, .RA, SFI, SMF, .SMP*, SND, *.WAV, HFS, ISO 9660, .VOC*.

fill: The sound between words in a production track that is used both to replace undesirable noise on the track and to create *handles* for use in extending the track at the beginning and the end.

F

filled: Filled effects is a version of the effects *stem*(s) of a *soundtrack* which includes all effects, including *cut effects* and *Foley*. See *M&E*.

fill leader: The film that is inserted into units of mag film in order to keep synchronization during silent sections. Fill leader is usually made up of recycled *release prints*. See also *leader*, *plastic leader*.

film: Now, 35mm film accommodates the 6-track digital sound, but previously almost all films released in 70mm from 1971-1992 were originally photographed in 35mm and then blown up to the 70mm format specifically for playback with 6-track sound. The motion picture exhibition format from 1955-1971, 70mm, contained 6-track magnetic sound, using camera equipment manufactured by *Todd-AO* and Panavision. The camera negative was 65mm wide, with the additional 5mm outside the sprocket holes used for the magnetic stripes on *release prints*. Almost all modern 70mm prints in the U.S. have no magnetic track, but instead use *DTS* in conjunction with a wide *timecode* track outside of the perforations.
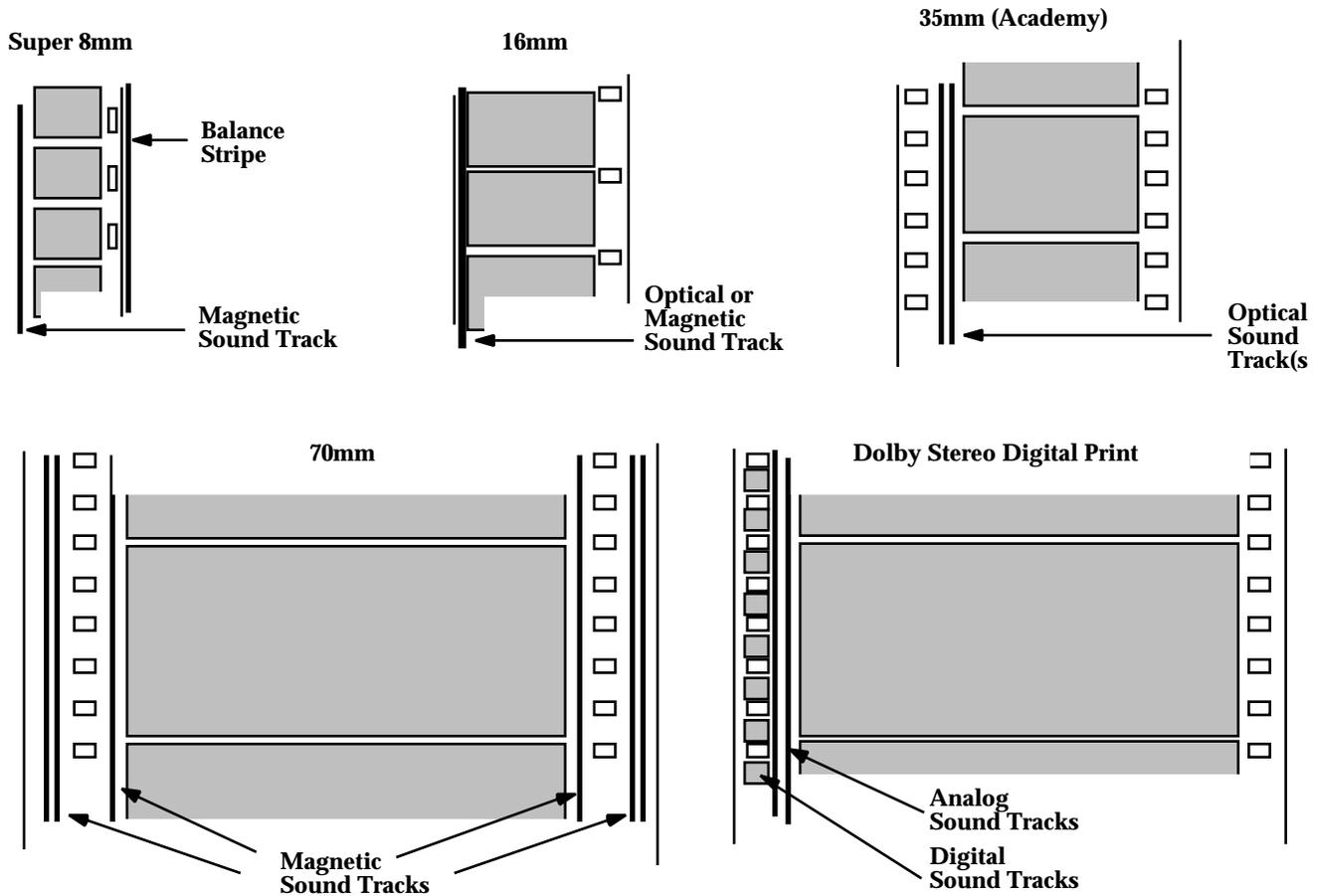
The image, in its widest and standard form has an *aspect ratio* of 2.2:1, which is narrower than the 2.4:1 *anamorphic* 35mm format that is the source of many 70mm prints. However, when *flat* 1.85:1 films are blown up to 70mm, they usually retain their original aspect ratio, with black borders on the side. the IMAX/OMNIMAX special venue format also uses 70mm film, although it runs horizontally through the camera/projector, and each frame is 15 *perfs* long, as opposed to the standard five perfs. Sound is always *double-system*, utilizing *mag film* or custom digital formats.

film chain: A device consisting of a motion picture projector and video camera, used to copy films onto videotape or to broadcast them directly. To adapt the 24 fps U.S. *frame rate* to the 30 fps NTSC video frame-rate, some chains use a projector with a five-bladed shutter, which shows each frame of film five times onto the vidicon tube of the video camera. The resulting 120 fps are regrouped four-at-a-time into 30 video images per second.

film footage: There are 16 *fps* per foot of a standard 35mm film image, each lasting four sprocket holes. At the standard rate of 24 fps, 35mm film runs at 90 feet per minute, or 18 inches per second. See *frame*.

F

film soundtrack: The audio component, including *DME*, of a film composition. There is usually a requirement for sound to be synchronized to the video image. This has been achieved by a variety of means, including the recording of sound on *optical tracks* etched into the film emulsion alongside the frames, fixing magnetic tracks on the film surface, synchronizing the film with a separate tape machine by means of mechanical sprockets, and electronic sync using systems such as *SMPTE*. See also *Dolby Stereo, LC Concept, optical track, SR.D, pilot tone, layback recorder, source track.*

Super 8mm

Balance Stripe

Magnetic Sound Track

16mm

Optical or Magnetic Sound Track

35mm (Academy)

Optical Sound Track(s

70mm

Magnetic Sound Tracks

Dolby Stereo Digital Print

Analog Sound Tracks

Digital Sound Tracks

Film Soundtrack Formats

filter: (1) A type of equalizing device for subtractively eliminating selected frequencies from the sound spectrum of a signal and perhaps, in the case of a *resonant filter*, increasing the level of other frequencies. See *VCF*. For example, a *lowpass filter* passes lower frequencies and removes the higher frequencies. By raising or lowering the filter *rolloff frequency* parameter, a sound will be made brighter or darker. (2) A device or MIDI software *filter* that eliminates selected messages from the MIDI data stream, usually called *MIDI filtering* by *data thinning*. See also *running status.*

F

filter resonance: The greater the *resonance* on a filter, the greater the effect of the filter: as resonance control is turned up, a little peak appears at the *rolloff* frequency. The *harmonics* that fall within that peak are accentuated. The greater the resonance, the higher the peak and the more pronounced is this effect. The effect of the swept resonant peak does not occur in real instruments. See also *Q*.

filter scaling: See *keyboard scaling*.

final mix: The mixing of the final *stems*, which, when mixed and replayed represent the film's finished *soundtrack*. In a stereo film (or surround-encoded TV programming) it is most common to record the *DME* stems on three pieces of 4- or 6-track magnetic film, *with Dolby-SR noise reduction*, or on analog or digital multitrack tape, or onto a *digital dubber*. These stems, also known as *dub masters*, are then used to create the *print masters*, the *M&E* mix, a mono mix, and possibly an airline version. For a non-surround-encoded stereo mix, then the stems might be in standard stereo format, but this precludes the subsequent production of a *5.1* mix, say for *DTV*.

finder: The user interface of the Mac operating system, allowing access to the file system, peripherals, and other components of the system hardware and software.

fine: The End.

fine cut: A stage in the editing of a film or video production at which the *workprint* or *EDL* is completed, denoting that the production is ready for final cut approval.

FIR: Finite Impulse Response: A class of *filter* designs whose impulse response falls to zero in a predictable, finite length of time, as opposed to an *IIR* (Infinite Impulse Response) design whose impulse response may never fully attenuate the impulse. A common use of FIR is to produce filters with a *linear phase response*. Filters such as analog *anti-aliasing filters* which have a very sharp *rolloff slope* produce unacceptable amounts of *phase distortion* in the output signal; FIR filters are used at the end of an oversampling *A/D* chain to eliminate any signal that would represent *aliasing* in the slower output datastream, without causing significant phase distortion.

F

FireWire: A digital audio transmission medium developed by Apple computer, designed to support dozens, possibly hundreds, of high-bandwidth audio streams. IEEE 1394 is designed to replace point-to-point AES/EBU connections, will support multiple data formats so that audio, video, MIDI, and control signals may all be send over a single cable. FireWire also distributes power as well as data, permitting hot-plugging of devices. IEEE 1394 is designed to be a fully specified bus, bi-directional and with the ability to broadcast from a single source to multiple receivers. Currently (late 1998) there is a 4.5–limit between any two adjacent nodes, designed to support a simple, low-cost clocking mechanism to be built into the standard to support isochronous data transfers for audio and video. The isochronous clock embedded within the IEEE 1394 standard runs at 8MHz, or one "tick" every 125μs. This is problematic for audio signals which require upwards of 44MHz clock rates, so the FireWire standard is being modified to address the problem of high-resolution synchronization. The signal can traverse up to a maximum of 16 hops, effectively extending the distance to about 70 meters. This was originally developed to support the transfer of high-bandwidth signals between computer peripherals; the multi-layer IEEE 1394 standard also allows the use of many other cabling technologies, including Category 5 twisted pair copper wire and 50mm multi-mode optical fibre, the later permitting distances between devices of hundreds of meters. See also *mLan*.

Comparison between SCSI and FireWire

	SCSI	Firewire
Number of devices supported	6	63 per segment
Connector size	Large-Medium	Small
Requires termination	Yes	No
Sets device ID automatically	No	Yes
More than one computer per segment	No	Possible
Device-sharing	No	Possible
Hot-pluggable	No	Yes
Topology requirements	Serial	None
Transmission method	Parallel	Isochronous
Computer required for data transfer	Yes	No
Standard Transfer rate	40 Mbps	400 Mbps
Maximum transfer rate	640 Mbps	800 Mbps min.
Maximum network length	12 meters	72 meters

fishing rod: See *boom*.

fixate: The process whereby a CD's overall lead-in, program data and lead-out areas are written. This is done during the *track-at-once* recording process when the final session is written, allowing all of the data contained on the disc to be read by any CD or CD-ROM drive.

fixed formant: A frequency characteristic of a sound, e.g., human vowel sounds are formants which are relatively fixed in frequency, even though the *pitch* of the voice may be changing as in singing. It is the fixed formant frequencies in the presence of the varying pitch of a musical instrument that shapes the instrument's *timbre* and makes the instrument recognizable.

F

flamming: An undesirable audio occurrence in which one of the instruments used on a rhythm track strikes slightly behind the others. It is caused primarily by the improper application of delay or tempo change.

flange: The round metal sides of a tape reel that keep the tape aligned as it winds onto the hub.

flanging: Named for the original *effects* technique where a second audio tape playback deck was slowed by a thumb on the reel flange, flanging is a special audio effect where a delayed version of a signal is mixed with the original signal, creating a swooshing sound. This is caused by the fact that when the time delay is different for the two combined signals, there will be frequencies where the phase-shift is 180˚ and the signals will cancel, causing deep dips or holes in the frequency response curve called the *comb filter* effect. As the speed is varied, the frequency of the dips is swept across the frequency range, giving the swooshing sound. Electronic flangers contain an adjustable electronic *delay line*. If the time delay is very short, the effect is called *phasing*. See also *notch filter*.

flat: (1) The condition of a note which is, either deliberately or accidentally, lowered in pitch. This might be only a few cents or as much as a tone (double flat, ♭♭). In music notation, a flat is indicated by the flat symbol (♭), meaning lower the tone by a *half-step*. (2) The same as *dry*. Unequalized, uncompressed, and otherwise unprocessed, describing a signal from any source: mic, instrument, or tape playback. (3) The neutral position on a *tone control*, effecting no change to the signal. See *center detent*. (4) Film projection using non-anamorphic lenses. In the U.S. the term flat is synonymous with an aspect ratio of 1.85:1 widescreen. See *anamorphic*.

flat response: The faithful reproduction of the *amplitude* of an audio signal, specifically, variations in output level of less than one decibel above or below a median level over the entire audio spectrum. A system which has the same gain at all frequencies of interest will yield a graph of the gain versus frequency that will be *linear*.

flattening: A general term for the process of moving the final stems, tracks, etc. to audio/video tape, usually involving a substantial reduction in the number of tracks on which the sound is carried and merged with the time-coded video. Also specifically refers to the process in ProTools™ whereby stereo audio and video is exported to a QuickTime movie or other format.

flat wind: To employ a slower-than-normal fast forward or rewind mode on a tape transport in order to wind the tape smoothly and evenly onto the reel or hub, usually for storage. Flat winding prevents edge curling and other types of deformation damage. See also *heads-out*.

Fletcher-Munson effect: Fletcher and Munson measured the sensitivity of human hearing at various volumes and frequencies with the finding that humans hear best in the range of 3kHz-4kHz; the sensitivity falls off rapidly at lower frequencies and somewhat more slowly at higher frequencies. In other words, very soft sounds must be more powerful at frequencies lower and higher than 3kHz-4kHz in order to be heard. The *loudness* control on music reproduction systems was designed to compensate for the Fletcher-Munson effect. See *equal loudness curves*.

F

flicker noise: At high frequencies, *intrinsic noise* is dominated by *Johnson noise*. At lower frequencies, there exists a critical frequency, f, at which noise rises proportional to $\frac{1}{f}$. Below this critical frequency, the noise is called flicker noise. Sometimes referred to as *flicker effect*.

floating unbalanced output: a $\frac{1}{4}$" phone-type output where the sleeve of the output stage is not connected inside the unit, and the ring is connected, usually through a small resister, to the audio signal ground. This allows the tip and ring to "appear" as equal *impedance*, not-quite-balanced output stage, even though the output circuitry is unbalanced. Floating unbalanced often works to drive either a balanced or unbalanced input, depending if a TS or TRS standard cable is plugged into the output. If a floating unbalanced connection hums, a *ground-lift* cable is required. Also known as a *pseudo-balanced* output, or *quasi-balanced*.

floor: In a *noise gate*, the amount of attenuation applied to an input signal whenever it is below the threshold level. For example, in a gate whose threshold is set to -10dBm and whose floor is set to -30dB, 30dB of attenuation is applied whenever the incoming signal drops below -10dBm.

flutter: (1) In a tape recorder, if the tape speed varies, the pitch of the recorded music will vary. If the rate of variation is fairly high, typically above 5Hz or so, it is called flutter. If the speed varies at rates below several *Hertz*, it is called *wow*. Flutter is actually a type of *frequency modulation distortion* and imparts a *tremolo-* or *vibrato-*like character to the music. (2) See *chatter*.

flutter echo: An acoustic effect where sound is reflected back and forth between two parallel surfaces such as walls. The same effect as *standing waves*, but at lower frequencies, flutter echo is created when reflections are lower than 15Hz, or when walls are greater than 25' apart.

flux: Lines of force surrounding a magnet. In measuring the strength of a magnetic field at a particular location, the number of lines of force per unit area in a plane perpendicular to the direction of the lines. The standard reference unit in magnetic tape for recording is the nanoweber per meter, and is called *flux density*.

fluxivity: The numerical measure of maximum *flux density* a specific type of recording tape can hold. *Reference fluxivity* is a standardized amount of flux, specified in nanowebers per meter, which is laboratory-recorded on a test tape at various frequencies. Such *reference tapes* are used to calibrate tape recorder 0dBVU playback levels.

fly in: (1) To mix sounds from a non-sync source into the live sound for a TV show, or into the mix for a videotape production or spot. One may fly in a narrator, Foley, etc. (2) To record sections from one or more tracks of a multitrack tape onto a second recorder (generally a two-track), then copy them back onto the multitrack in another section of the performance. For example, one might take the background vocals from one chorus and fly them into another section of the song. Short fly-ins can be done without *SMPTE* sync, although it is somewhat difficult.

FM sync: The 13.5kHz frequency-modulated *sync pulse* recorded on *Nagra* IV-S recorders.

F

FM synthesis: A *sound synthesis* technique which multiplies *sine waves* together in an attempt to generate complex waveforms more quickly (than *additive synthesis*), usually adding several of these products together in an attempt to get its more effective results, which is why a 6-operator FM sounds better than a 4-operator FM as more products are being summed. See *sound synthesis.*

foldback: The general term for the part of a *sound reinforcement* system in an auditorium which supplies amplified sound to the performers so they can hear themselves. See *monitor mix.*

foldback send: See *monitor send.*

foldover: See *aliasing.*

Foley: Creating sound effects by watching the picture and mimicking the action, often with props. Foley artists, also known as *Foley walkers*, make use of a variety of objects and/or surfaces to elicit realistic sound effects; most commonly used in the recording of on-screen footsteps, hence the term "walkers." Foley effects are named after Hack Foley, who was the head of the sound effects department at Universal Studios. The audio track which contains Foley sounds is known either as a *cloth track* (west coast) or *rustle* (east coast.)

footage counts: See *counts.*

formant: A frequency band in the spectrum of a voice or musical instrument that contains more energy or amplitude than the adjacent area, i.e., the partials are quite closely spaced in the region, giving the sound its *timbre.* For example, the formants produced by the human vocal tract are what give vowels their characteristic sound. See *fixed formant.*

format: (1) In vinyl records, the size of the disc and its rpm rating. (2) The physical specifications of a specific film or print, e.g., 35mm, as will as the type of soundtrack (optical or magnetic, stereo or mono, with or without *NR*), whether it is color or b/w. (3) The width of a videotape, and the designation of the electronic system by which it is recorded. (4) In radio and TV, the type of programming featured. (5) *Magnetic tape* format. For any tape recorder or recorded tape, the number of tracks, their width and position with respect to the tape, and the overall width of the tape itself. Tape speed is not always included, e.g., 8-track 1" and 24-track. This is usually called *track format.* (6) See *file format.*

forward masking: See *temporal masking.*

Fourier analysis: A technique, usually performed using a *DSP* algorithm, that allows complex, dynamically changing audio waveforms to be described mathematically as sums of sine waves at various frequencies, amplitudes, and phases. The Fourier transform allows a function that represents an audio signal (signals are in the time domain because they exist in time) to be transformed to another function which represents the same signal in the frequency domain. The signal in the frequency domain is called a *spectrum*, and the same signal in the time domain is called a *waveform*.

F

four-stage envelope: The Yamaha DX7 synthesizer introduced a new type of envelope generator, one which had four *rate control* and four *level control* parameters, for a total of eight *parameters*. Each rate parameter controls how long it takes the envelope to move from one level to the next. This is referred to as a four-stage envelope because each rate/level pair is considered a stage. Technically, an ADSR envelope only has one true stage, the decay/sustain stage and two more partially controllable stages because the attack and release levels are fixed at 100% and zero, respectively.

fourth: The interval between a note and the one five half-steps above or below it. See *interval*.

four-track: See *quarter track*.

fox holes: Small perforations on 35mm *release prints* that allowed for the addition of *mag stripe* for the *CinemaScope* process. This process has now largely been replaced by *Dolby Stereo*.

fractal music: Music created by the use of fractal equations. By assigning musical parameters such as pitch and volume to the x and y axes, it is possible to produce music as the Mandelbrot set is calculated.

frame: (1) The internal structural support of a *loudspeaker* when holds the *voice coil* and the *diaphragm*. (2) The basic unit of *SMPTE timecode*, corresponding to one frame of a film or video image. Depending on the format used, SMPTE time can be defined with 24, 25 30 or 29.97 frames per second (fps). (3) In digital audio, a frame is a unit of digital information. In the CD, a frame covers six sampling periods, or 136μs.

Usage and Country	Frame Rate per Second	Time per Frame
UK and European Film industry	24	41.66ms
UK and European video and TV	25	40.00ms
USA B/W TV and video	30	33.33ms
USA Color TV and video	30 drop-frame (~29.97fps)	33.37ms

frame lock: Frame lock maintains synchronization between master and slave transports, using the positional information available in the timecode address. Also called *frame sync*. See *SMPTE timecode*.

frame rate: See *frame*.

free encoding: An extension of *spaced microphone recording techniques*, systems which create pseudo-stereo from a mono source will also generate a strong surround signal, and stereo-width controls can be used to manage the balance between frontal and surround channels. Increasing stereo width also increases the level of the surround channel, whereas decreasing width reduces the surround content. This is because a surround decoder will automatically send anything which is of a similar level, but opposite polarity between left and right channels, straight to the surround output. Artificial reverberation, for example, is automatically spread across L, S, and R. See *LCRS*.

F

free-field: A sound source radiating into three-dimensional space where there are no reflecting surfaces is said to be radiating under free-field conditions. The *SPL* as measured at various distances from the source would obey the *inverse square law* precisely. There is no such thing as a true free-field, but it is approximated in an anechoic chamber. Because all rooms have at least a small amount of *reverberation*, the sound field from a source is always contaminated with reflected sound. See also *far-field*, *near-field*, *reverberant field*.

FreeMIDI: A Macintosh operating system extension developed by MOTU that enables different programs to share MIDI data. For example, a sequencer could communicate with a *librarian* program to display synthesizer patch names, rather than just numbers, in the sequencer's editing windows.

freewheeling: A condition in which a clock *synchronizer* continues to generate *timecode* even when it encounters *dropouts* in the timecode source, or in which a digital audio playback device continues to generate audio in the absence of, or while ignoring, a timecode input. See *jam sync*.

frequency: The number of waves (or cycles) arriving at or passing a point in one second, expressed in *Hertz*. See *pitch*, Appendix D.

frequency distortion: Frequency distortion results when the amplitude of the output of a system or a device varies as the frequency of the input varies, while the amplitude of the input is held constant.

frequency doubling: See *doubling*.

frequency masking: An audio artifact which occurs when several sounds are mixed, all which occur in the same frequency range. This happens because human ears tend to blend simultaneous sounds into a single, composite sound. When several instruments or other sounds emphasize similar frequencies, those frequencies accumulate and can either become too dominant or can cause one sound to mask another. Also called *band masking* or *auditory masking*.

frequency modulation (FM): (1) A change in the frequency (pitch) of a signal. At low modulation rates, FM is perceived as *vibrato* or some type of *trill*. When the modulation wave is in the audio range, FM is perceived as a change in *timbre*. FM synthesizers, commonly found on soundcards, create sounds using audio-range frequency modulation. See *FM synthesis*. (2) Frequency modulation is the instantaneous changing of the frequency of a carrier in response to a modulation signal, usually an audio waveform. As the signal voltage varies up and down as it follows the waveform, the frequency of the carrier varies up and down from its nominal unmodulated value. The FM receiver is tuned to the carrier frequency, and the received signal, after suitable conditioning, is applied to a special circuit called an FM *detector*, also called a demodulator or discriminator, which recovers the audio signal. See *amplitude modulation*.

frequency modulation distortion: Examples of frequency modulation distortion are *flutter* and *wow*, and *Doppler distortion* caused by the motion of rotary (Leslie) loudspeaker cones.

frequency ratio: The ratio of the higher *pitch* in an i*nterval* to the lower pitch. See *consonant*, *harmonic*.

F

frequency response: The amplitude response of a system or device as a function of the input frequency characteristic. It is a complex function which describes the way in which the *gain* and *phase* of a system or device vary with the frequency of the stimulus. Frequency response is a characteristic of a system or device, not a characteristic of a signal. See *linear*.

frequency response curve: A graph of the *frequency response* of a device, i.e., the graph of its output amplitude response vs. the input frequency. See *linear*. For example, the frequency response curve for a microphone is a graph of the mic's output level in dB at various frequencies. The output level at 1kHz is placed on the 0dB line and the levels at other frequencies are placed above or below that reference level. The shape of the response curve suggests how the mic sounds; a wide, flat response tends to sound accurate and natural. A rising high end or a *presence peak* around 5-10kHz sounds more crisp and articulate. Note that the response curve is measured at a specified distance from the mic, usually 2-3 feet; the curve reflects the performance of the microphone only for that particular distance.

frequency response errors: Any deviation from a *linear* output response in an audio device.

frequency shifter: A device that linearly shifts all the frequencies of a complex input signal. Also called a *spectrum shifter*. All frequency components are shifted linearly, i.e., by the same number of *Hertz*, in contrast to a *pitch-shift*. In a pitch-shift, all the frequency components are shifted by a constant percentage, and therefore, high frequencies are shifted proportionally more than lower ones. A pitch-shift-by-speed change thus preserves all the musical intervals between components. A true frequency shifter, in contrast, destroys the *harmonic* relationships between the components. The sound of a consonant musical tone becomes disconsonant or *clangorous* or harsh, depending on the amount of shift. Frequency shifters are used in electronic music synthesizers for special effects.

fringing: A rise in the level of low frequencies when a recording is replayed by a tape head with a narrower track width than the one used to record the tape. Low frequencies from the recorded areas adjacent to those actually being played back *bleed* into the playback signal.

FSK: Frequency Shift Keying. FSK is a sequence of two alternating audio tones, typically generated by a sequencer, drum machine, or computer MIDI interface, that is recorded on one track of an audio or video tape for synchronization to MIDI sequencers and drum machines. See *pilot tone*.

full-coat: Magnetic film coated with oxide across its entire width, available in 16mm and 35mm widths. Contrast with *full stripe*. See *mag film*.

full code: A term meaning that a sample word is set to all ones, i.e., that it is representing the largest number possible at that word length. This is important in the representation of digital audio amplitude, where a full code word is equivalent to -0dB *headroom*, or the amplitude that is the loudest sound which can be encoded without *clipping*. See also *digital black*.

full score: A notated form of a piece of music which contains the complete music for all instruments or vocal parts, aligned vertically, i.e., the full complement of *band parts*.

full-stripe: Magnetic film with oxide coating in just the area where the recording takes place, allowing the transparent material to be written on. Contrast with *full coat*.

F

fullth: A subjective term applied to a recorded musical program with many voices in the lower mid-range of frequencies, e.g., cellos and violas, background vocals, rhythm piano, etc., giving the mix a lush or heavy richness. Also called *gush*.

full-track: A $\frac{1}{4}$" tape *format* in which a single, mono track is recorded across the entire tape width. Loosely used to refer to wider tape formats in which each of two or four tracks is $\frac{1}{4}$" wide.

fundamental: The perceived *pitch* of a sound; the lowest frequency vibration component in a complex sound which also carries a set of higher-pitched vibration called *overtones*. The fundamental is always the first *harmonic* and/or *partial* component of a sound. See *DCO*.

fusion: In *stereophonic* music reproduction, fusion is the perception that sounds from two or more loudspeakers are being produced by a single sonic *image*.

fuzz box: An effects device designed to produce *clipping* distortion, most frequently used with electric guitars. See *DI*.

fx: See *effects*.