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IDE: Integrated Disk Electronics. A standard interface *bus* in PCs, most commonly used for hard disks. EIDE is Enhanced IDE, somewhat faster than the original IDE specification. This later evolved into ATA (Advanced Technology (AT) Attachment) and UltraATA. This evolution is fairly parallel to the *SCSI* bus technology used by Macs.

IEC characteristic: The European *pre-emphasis* and *de-emphasis* equalization standard for magnetic tape recording.

IEM: In-Ear Monitor. Earphones used by musicians when recording to hear a special *cue mix*, *overdubbing*, or during a performance to better hear other musicians. Sometimes used instead of *stage monitors* to reduce problems of feedback or to provide each musician with a separate *monitor mix*. See *earwig*.

IFPI: **International Fédération Phonographique Industrie.** The European equivalent of the RIAA.

IIR: Infinite Impulse Response. See *FIR*.

IMA: Interactive Multimedia Association.

image: (1) The apparent relative placement of individual sound sources, as imagined by a listener of recorded audio, created during the recording and mixing processes, as well as by the final format of the media, e.g., *stereo*, *surround-sound*. See *imaging(1)*, *Haas effect*. (2) See *imaging(2)*.

image shift: In *multichannel* sound reproduction, a change in the apparent left-to-right position from which a particular sound seems to emanate.

imaging: (1) The ability to localize the individual instruments, voices, or other sound sources when listening to a *stereophonic* recording is called imaging. Accurate imaging with two channels is almost impossible, requiring both channels to have identical *gain* and *frequency response*, the two loudspeakers to be within 1dB of each other in frequency response and the *phase* must be identical. In addition, the listener must be precisely between the two speakers. The lack of accurate imaging with traditional, two-channel stereo has led to three-channel (LCR) and higher-channel audio recording and reproduction in an attempt to improve the listening experience. Contrast with *stereo spread*. (2) The resulting output of a *D/A converter* is a stair-step waveform which contains a great deal of high-frequency distortion called *images*. To reconstruct a smooth replica of the original signal, the stair-step is passed through a steep lowpass filter called an *anti-imaging*, or *reconstruction filter*. See *quantization error*.

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impedance (Z): The opposition (measured in ohms) of circuit elements to an *alternating current*. The impedance includes both *resistance* and *reactance*. In an AC circuit, resistance presented to the current is a function of frequency, called impedance and is also measured in ohms. Ohm's law can be used for AC if the reactances are zero, that is, if there are no capacitors or inductors in the circuit. See Appendix B.

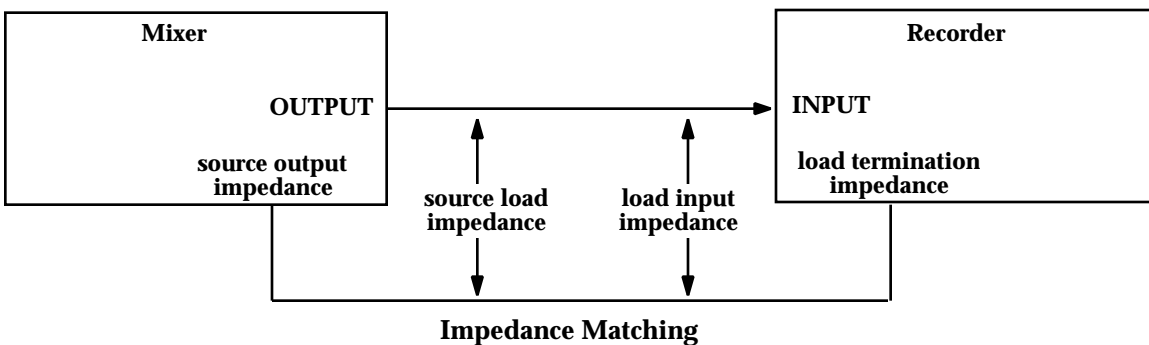
source output impedance: the actual impedance of the output circuit. The output impedance of a device determines just how much current it can provide to a load.

source load impedance: the impedance that the source circuit is designed to serve as a load. This is usually the figure given in the specifications, e.g., the impedance value that the equipment was designed to be connected to.

load input impedance: the impedance that the load is designed to be fed from. As long as this value is higher than the source output impedance, the rest doesn't matter. For example, if a tape recorder is connected to a mixer, this value is the impedance that the recorder wants to serve at its input.

load termination impedance: the actual impedance of the input circuit.

impedance-matching: If the absolute maximum power is to be transferred from a source to a load, the impedances must match exactly. The source impedance output, the cable impedance, and the load impedance input have to be equal. This is called a *matched circuit*. However, when a circuit is matched, the voltage swing is reduced 6dB, lowering the best possible *S/N ratio* by that amount. Because of low-noise preamplifier circuits, there is a better audio trade-off of power transfer for a larger voltage swing. Therefore, the idea that circuits should be impedance-matched is fallacious, and instead modern audio equipment should simply be connected via *balanced* input and output lines. Systems that use high impedance mics are limited to cable lengths of around 10' or so, but there is no reason to worry about the actual impedance value; it is either high or low. See *bridging circuit*.



impulse response: Impulse response is the manner in which a device (usually a transducer of some sort) behaves after the initial energy input (sound) has stopped. An impulse is a signal or sound that has a very short, in fact, a vanishingly small, duration. A true mathematical impulse has zero duration and infinite amplitude, but still a finite amount of energy. The energy in an impulse is spread evenly over a wide frequency band, and this means that it can be used as a test signal to measure the characteristics of an audio device. The impulse response *convolved* with an input signal gives the output response.

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in-band gain: The standard for adjusting subwoofer response such that the subwoofer SPL, within the operating range of the loudspeaker, is louder than a full-range speaker in the same frequency range. All modern digital film sound formats use 10dB of in-band gain.

inches-to-millimeters: Useful when trying to deal with European tape widths:

inches	mm
2	50.8
1	25.4
0.5	12.7
0.25	6.35
0.125	3.175

incident sound: The first (audio) source event to reach the sensor. Also called the *incident wave*, *direct wave*, *primary wave*, *first arrival*. See also *reverberation*.

incoherent: Two complex *waveforms* that are partially or completely out-of-phase most of the time. This happens when a sound source is recorded with microphones placed with different distances between the microphone and the sound source. *Coincident pair* and *spaced pair* microphone placement is designed to produce a *coherent* stereo sound field.

inductance (L): The capability of a coil to store energy in a magnetic field surrounding it. It produces an *impedance* to an AC current. Inductance is measured in *Henrys*, although *milli-Henry* is more common.

induction: A common means by which extraneous signals enter the audio path is through *induction*. All *current* produces a corresponding electromagnetic field that radiates from the *conductor* carrying the current. Conversely, a radiant electromagnetic field can induce current in a nearby conductor, introducing unwanted signals into an audio cable. *Balanced lines* are much less susceptible to induced noise because of the *phase reversal* in the wires. Two common sources of induced noise are *RFI* and *EMI*.

inductor: Used most often in *crossovers* and *filters*, an inductor is an electronic device which presents a low *impedance* to DC (it allows it to pass), but an increasing impedance to AC as frequency rises. It has the opposite characteristic to a *capacitor* and is physically a coil of wire, sometimes with a ferrite core.

inertance: In acoustics, a sound barrier's opposition to the flow of energy through it, analogous to the inductance of an electronic circuit, and measured either *broadband* or *split-band*. Since a dense, highly reflective barrier exhibits high inertance, the term is not necessarily related to the *absorption coefficient* or *sabine ratings* of surface or insulating materials.

infinite baffle: A loudspeaker which is constructed in a totally *sealed enclosure* so that it completely separates the sound radiated from its back. The opposite of a *ported enclosure*.

infrasonic: Sounds or signals whose frequencies are below the normal human hearing range, about 20Hz, sometimes incorrectly called *subsonic*.

initialization: The process of reading the table of contents from a CD after it has been inserted into a CD player. The player then displays the track numbers recorded on the disc. See *Control and Display signals*.

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initialize: To reset a piece of equipment or program so as to revert to the parameter settings stored in its ROM, usually the factory presets.

inharmonic: Containing frequencies that are not whole-number multiples of the *fundamental*. See *harmonic, partial, clangorous*.

in-line: A configuration for input channels on a mixer, where the *tape returns* are connected via a parallel and additional line input to the channel. This obviates the need for a separate tape monitoring section on the desk, hence the tape returns are said to be *in-line*. The advantage is that, during remix, the input channels are all available as inputs, allowing all available tape tracks to be mixed from all available tracks of audio from synthesizers. Thus, *in-line* operation effectively doubles the number of inputs on a mixer. The opposite of a *split console*-type mixer.

in-position sampling: A technique for miking drum kits which uses two matched microphones in an *X-Y* arrangement, typically using large-diaphragm, condenser-type microphones. The main focus of *in-position* sampling is preserving the *stereo spread* of the kit and producing a punchy drum sound.

input: (1) The connector by which a signal enters an electronic device. (2) The incoming signal, itself. (3) An electronic operating mode in tape recorders, in which the input signals to various tracks are routed directly to their outputs.

input level: The signal voltage or *power* present at the input of a device. See *headroom*.

input stage: That portion of a *mixer* which consists of the microphone *preamplifier*.

insert editing: Used in videotape or digital audio editing to describe the process of replacing a segment located between two specific and previously dubbed segments. The editor usually refers to *SMPTE timecode* numbers.

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insert point: Typically found on a *mixer*, but also on some other audio devices, a point at which a signal may be diverted through a *breakjack*. Inserting a plug breaks the bypassing connection and makes a new connection through the plug to the outside world. There may be two sockets involved with a normalled connection, one marked *send* and one marked *return*. On a mixing desk, the input might be connected to the send terminal of an insert point for sending the signal to a device such as a compressor, which then returns the modified signal back into the channel. If no such unit is plugged in, the signal bypasses the insert point. See *channel insert*, *aux send*.

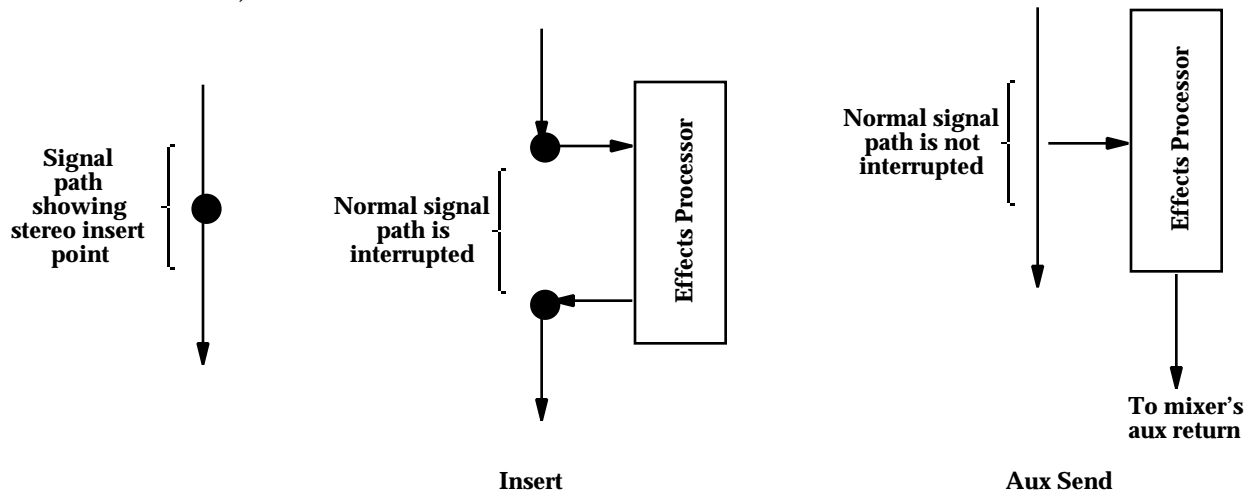


Diagram showing difference between an insert and an aux send

insertion loss: Signal level loss due to the addition of a *passive* audio device, such as *crossover networks* and *equalizers*, into a sound system, and measured in dB. There is also an *insertion gain* from amplifying circuits, but the term seems not to be widely used.

insulator: A material that is *non-conductive*, i.e., usually a material used to separate wires carrying electrical signals. Elements with few free electrons are the best thermal or electrical insulators.

integrator module: A *lowpass filter* which increases the rise and fall times of a sound *envelope*, lengthening the *attack* and *decay* times. Compare with *differentiator module*.

integrated amplifier: A consumer audio component consisting of a preamp and power amp all in one chassis.

integration time: The time it takes for the human aural system to register and understand a sound. For example, human hearing more closely resembles a VU meter than a peak meter in that a very quickly peaking sound, such as a drum, may actually be very loud on an absolute scale, but is not perceived as loud as the decay is well in progress before the sound is fully processed, i.e., heard.

intensity: The strength of a signal or the brilliance of a video image.

intercut: (Old) The original *magnetic recording tape* editing technique where a section of the master tape is physically cut out and replaced with another *take* using splicing tape.

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interference microphone: See *gun microphone*.

interleaving: An *error-concealment* scheme in which data words or samples generated in sequence by the *A/D converter* are separated into defined subgroups such as odd- and even-numbered words within a longer sequence. Each subgroup is then recorded after its mate, shuffling originally adjacent words to positions somewhat far apart on tape. This is done to allow the reconstruction of continuous valid data in the event of large-scale drop-outs, burst errors, or other extended read error problems. *Cross-interleaving* further shuffles the interleaved data into yet smaller subgroups. The *CIRC* system, used in CD reproduction, combines several error-concealment algorithms, including cross-interleaving.

interlock: (1) A term that generically refers to two or more machines running in synchronization, often shortened to *locked*, or *synched*. (2) The projection of film footage and its corresponding sync sound, either the magnetic film transferred from the original sync tapes, or the completed final mix, in synchronization. (3) The system by which the projector and sound playback are synchronized during projection.

intermodulation distortion: While *harmonic distortion* adds frequencies that are harmonically related, intermodulation distortion adds nonharmonic *partials* to the original signal. IM is a measure of how two frequencies that are present at the same time affect each other. *Amplitude intermodulation distortion* is caused when combinations of two or more frequencies generate new frequencies which are sums and differences of the original signal, i.e., the *amplitude modulation* of one signal by another. If an amplifier is used to amplify each tone equally, but if the gain of the amplifier varies with signal level (i.e., it is nonlinear), high-frequency sounds will be amplified by different amounts depending on whether a nearby low-frequency sound is near zero or near its peak. Therefore, the high-frequency signal will undergo changes in amplitude at the rate of the low-frequency signal, modulating the high-frequency sound which will be heard to *flutter* in the presence of the low-frequency sound. *PIM* is another component of intermodulation distortion, but to a lesser degree.

international version: See *M&E*.

internegative: Laboratory film element that is made from an *interpositive*, used to make *release prints*. This is done because the prints can be made at high speed, and to protect the *EK neg*.

interpositive: Laboratory film elements made from the original camera negative in preparation for making either an *internegative* or to be used in a *Telecine* machine to transfer the film image to tape. (Unless no other version is available, release prints are never used for video transfers.) Also known as an *IP*, an interpositive contains shot-to-shot color correction so that internegatives can be made with no further color adjustments, although further adjustment is usually necessary when doing film-to-tape mastering. If the camera negative was cut into *AB rolls*, than the *IP* can incorporate first-generation *fades* and *dissolves*.

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interval: The difference in *pitch* between any two musical notes. The interval corresponds to a frequency ratio, but intervals are referred to by name and are based on the *octave* in a *diatonic scale*.

For example, a *fifth* is the *interval* of the *diatonic scale* between the *tonic* and the *fifth note* of the scale, etc.; the *fifth* has a frequency ratio is 1.5:1, or 3:2. The next most consonant interval to the *octave*, the second *harmonic* of the higher tone will have the same frequency as the third harmonic of the lower tone so that the two tones blend together well. The musical interval between the second and third harmonics of a musical sound is a fifth. For the key of C:

C	Tonic	G	Perfect 5th
C	Minor 2nd	G	Minor 6th
D	Major 2nd	A	Major 6th
D	Minor 3rd	A	Dominant 7th
E	Major 3rd	B	Major 7th
F	Perfect 4th	C	Octave (Tonic)
F	Tritone		

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in the mud: Slang term for a signal level or level on tape that is too low, i.e., hardly moving the meters.

in the red: Slang term for a signal level or level on tape that is too high, i.e., above 0dBVU, and thus likely to produce distortion.

intonation: The tuning of a musical scale, such as *meantone*, or *just intonation*. See *temperament*.

intrinsic noise: The intrinsic noise of any (electronic) system is the noise which is a function of the real part of the input *impedance* and the temperature, i.e., noise which is inherent in the system itself, as opposed to being induced by any source external to the system or device. See *Johnson noise*.

intro: Short for introduction. The beginning phrase of a musical composition, often unrelated to the remainder of the piece in either *key* or *tempo*. The opposite of an *outro*. See also *bridge passage*.

inverse square law: A small sound or light source radiating energy into three-dimensional space produces an intensity which falls off in inverse proportion to the square of the distance from the observer to the source. This means a reduction of sound pressure of 6dB for each doubling of distance if the sound source is in a *free-field*.

inversion: (1) A transformation of an *interval* which can occur in two ways. In *intervallic inversion* where two notes are played together, the lower note of the original is played an *octave* higher (or the upper note is played an octave lower). This causes an interval of a *fifth* to become a *fourth* and vice versa, an interval of a *third* to become a *sixth* and vice versa, etc. It is an arithmetic phenomenon that the original interval and its inversion always sum to nine. In *melodic inversion*, the interval between one note in a melody and the next note is inverted, so if the melody originally rises by a *third*, the inverted melody will fall by a *third*. (2) A transformation of a chord through intervallic inversion such that the original bass note no longer remains the lowest note of the chord. A major or minor triad can appear in three positions:

The diagram consists of three musical examples on a five-line staff in treble clef:

- Example 1:** Shows two notes, A and D, on a staff. A is on the second line and D is on the third space. Brackets below indicate the interval is a fifth. Below the staff, it says "A fifth" and "When inverted becomes a fourth".
- Example 2:** Shows a rising third interval: D (second space) to F (third space), and then a falling third interval: D (third space) to B (second space). Brackets below indicate these intervals. Below the staff, it says "A rising third" and "When inverted becomes a falling third".
- Example 3:** Shows three chord positions for a triad: "Root Position" (C, A, F), "First Inversion" (F, C, A), and "Second Inversion" (A, F, C). The notes are shown as vertical stems with dots on the staff.

Inversions

invertig amplifier: See *differential amplifier*.

IP: See *interpositive*.

ips: Inches per second. See *cps*.

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IRCAM: Institute de Recherche et de Coordination Acoustique/Musique. Founded in Paris, IRCAM organizes and provides facility for research in music and acoustics as well as composition and performance.

iron: See *chain*.

IRQ: Interrupt ReQuest level. In PCs, the peripheral device bus address, somewhat analogous to a SCSI ID number on a Mac.

ISC: International Steering Committee. A committee set up by the RIAA, RIAJ, the IFPI to set standards for new audio recording formats.

ISDN: Integrated Systems Digital Network. A digital telephone network hawked by the telephone monopolies as they can run the long-haul links over their existing analog plant. As the end connections are ultimately digital, there is no *modem*, only a *codec*. ISDN services include audio and data transmission, as well as the other usual telephone company add-ons such as caller ID, call waiting, etc. The basic unit of ISDN is the B-Channel (bearer channel) which are 64kbps (yes, that's a whopping 64 *kilobits* per second) of bi-directional datastreams of audio, video, or computer data. There is an auxiliary D-Channel which is used as a control circuit, but is used by the APT codec to carry SMPTE data.

With ISDN, one pays per B-Channel, and once allocated to the user, the costs of transmission on the multi-channel circuit are fixed, regardless of the actual data rate used over the circuit. However, with a multi-channel installation, the circuits are not guaranteed to travel the same route to the destination, resulting in varying transmission delays, resulting in garbage at the destination node. Many codecs are now able to handle the multi-channel circuits, but providing timing to SMPTE timecode resolution is unfeasible so, in practice, either mixes are downloaded at the receiving end and rebuilt using SMPTE timecode for synchronization, or to send the monitor mix, and in real-time, simultaneously record the performance back onto the master tape, also via ISDN. The overdubbed audio will be offset by a fixed time constant, so the delay remains fixed, and the tracks are re-synced after recording.

There are three commonly used types of ISDN audio codecs: Dolby Fax, APT x100, and MUSICAM (MPEG). Dolby Fax is used by the movie studios and high-end recording facilities, with about 300 installations world-wide; it is based on AC-2 encoding; it requires four B-channels. APT (Advanced Processing Technology, owned by SSL, Inc.) developed the data reduction called "x100." This format is widely used by broadcasters, and has been adopted as the encoding standard of DTS. APT offers the shortest processing delay of all of the common ISDN data-reduction systems, and the highest bandwidth of up to six B-channels, with concurrent SMPTE time-code. The MUSICAM format uses MPEG and is again widely used by broadcasters; it requires from one to six B-channels. Depending on where and who you are, ISDN is either the wave of the future, or the backwash of the past (as it's all the telephone companies have to offer).

ISO: International Standards Organization.

ISO 9660: The ISO 9660 CD format is a standard logical file format that can be read by both Macs and PCs. Compare with *HFS*.

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isochronous: Strictly speaking, isochronous means, “having a periodic nature.” Sine waves are isochronous. In audio-speak, however, isochronous usually refers to two signals which, while produced at the same *sampling rate*, are not *synchronized*. In this case, due to small variations in the clocks which drove the sampling frequency, the two signals will eventually drift out of synchronization, even if started at precisely the same time. Isochronous signals are a problem when attempting to play back audio, video, and/or control signals which require timecode-accurate alignment for the very accurate long-term synchronization of sound and vision. See also *FireWire*, *coherence*, *incoherent*.

isolating transformer: A transformer, typically with equal primary and secondary coils used to provide power to a piece of electrical or electronic equipment. The lack of a direct connection between the primary power source and the secondary load improves the safety factor for the user of the equipment.

ISRC: International Standard Recording Code. A standard label the recording industry attaches to its products offered for sale.

ITC: Intermittent Traffic Control. Film production term for the presence of traffic control during on-location filming.