

The Astin Trew Dictionary of Hi-Fi Terms 2008

We have compiled this A-Z of terms as a 'quick guide' for you. We've kept away from very detailed explanations, as there are many other places on the internet where it is possible to find more detailed and technical information on every topic and term covered below.

As technologies advance and more audio (and visual) product goes digital, we hope this A-Z might be useful if you come across terms you are not familiar with. We have also included terms that are common across Hi-Fi and pro-audio fields, as these areas are increasingly merging as well, along with more basic electrical terms.

If there are any (and there will be) omissions or errors, please do get in touch and we'll update for next year's edition. Thank you.

Numeric

1/4" or 6.25mm jack See *Jack plug*.

1/8" or 3.5mm jack See *Jack plug*.

2-way loudspeakers A loudspeaker which divides the incoming signal into two different frequency bands (normally through an electrical circuit crossover) for distribution to two drivers, normally, a bass/mid range and high frequency tweeter.

2.1 The number of channels offered by some amplifiers, allowing two channel (stereo) and one dedicated 'sub bass' channel. The 0.1 sub bass signal is normally a buffered line level output for use with an 'active' loudspeaker (bass speaker enclosure incorporating amplification). The '0.1' refers to the one Low Frequency channel, which is not full range but designed to cover up to around 120 hertz, thus the decimal point in 2.1 perhaps?

2.5-way loudspeakers A loudspeaker which divides the incoming signal into three different frequency bands for distribution to the drivers, but different to three-way speakers, in that it sends high frequencies to the tweeter, low frequencies to one or more woofers; and the midrange frequencies, combined with low frequencies to an additional bass/midrange driver, in the same way as is done in a two-way speaker system. Therefore, all but one of the large drivers handles bass only, while the last handles both bass and midrange.

3 way loudspeakers A loudspeaker which divides the incoming signal into three different frequency bands (normally through an electrical circuit crossover) for distribution to three drivers, normally, a bass, a mid range and high frequency tweeter.

4 way loudspeakers A loudspeaker which divides the incoming signal into four different frequency bands for distribution to drivers. It sends high frequencies to the tweeter, upper middle frequencies to a small midrange driver, lower middle frequencies to a larger midrange driver, and the lowest frequencies to one or more woofers. It is possible to have as many 'ways' as you want, but the crossover becomes increasingly complex.

5.1 The number of channels of audio in a modern movie. The '5' refers to full range channels: moving clockwise, left front, centre front, right front, right surround and left surround. In Dolby Digital, DTS and MPEG 5.1 formats, each of these five channels is capable of a frequency response covering the full audible range (up to 20,000 hertz) and one sub bass channel. Enhancements of the 5.1 channel surround system appear in both Dolby Digital and DTS. The Dolby Digital version is called Dolby Digital EX 6.1 while the DTS version appears as either DTS ES 6.1 Discrete or DTS ES 6.1 Matrix. The additional channel is intended to sit at the rear of the room (although two speakers are recommended, even though the same signal is provided to both). This provides a greater localization of sounds from the centre rear. This is a very useful enhancement in cinemas where much of the audience are sitting off-centre, but in normal rooms with a small number of viewers, it is much less important.

6.25mm jack See *Jack plug*.

A

AAC *Advanced Audio Coding* - a lossy audio encoding scheme used, for instance, by iTunes / iPod.

A/V *Audio/Visual*. Most TVs and PCs have outputs to allow high quality sound to be produced (through additional amplifiers and loudspeakers) to enhance the entertainment value of films, music videos and TV programmes.

AC *Alternating Current*. An electric current that reverses direction regularly. More generally, AC is also used to describe voltage sources in which the polarity of the signal reverses regularly. Power distribution networks use AC because it is relatively easy and cheap to alter the voltage (using transformers) yielding

considerable economies for long distance power transmission. Virtually all the countries in the world use either a 50 or 60 hertz frequency for their power systems. Europe, Australia and India use 50 hertz. The Americas and Japan use 60 hertz. See also *DC*.

AC-3 The encoding scheme used in Dolby Digital, the name by which it is now more commonly known.

Acoustic suspension Also called infinite baffle. A design for the enclosure of a loudspeaker. The enclosure is sealed so that it is air tight, which causes the air within to become a very active part of the woofer's suspension. This raises the resonant frequency of the driver and lowers its compliance. Acoustic suspension speakers tend to be less efficient than bass reflex designs, and the bass notes begin fading away at a higher frequency, but tend to be less than an equivalent bass reflex speaker, so they frequently produce greater bass extension.

Active loudspeaker A loudspeaker with built-in amplification for all the drivers. Some speakers have an amplifier built-in for bass only, but these are not regarded as active. Most loudspeakers are passive, not active.

Active subwoofer Subwoofer with built-in amplification. Most subwoofers are active, not passive.

ADC *Analogue to Digital Converter.* A component, circuit or device that converts an analogue signal to a digital one, usually to some form of **PCM**. Compare **DAC** which does the reverse.

AES/EBU *Audio Engineering Society/European Broadcasting Union.* A digital audio communication standard most commonly seen in professional audio applications. Electrically it is only subtly different to the consumer-oriented S/PDIF standard, the main variation being a different method of handling the clocking signal, and it generally being carried by balanced connections. Nevertheless implementations are seen that seem to be fully compatible with unbalanced S/PDIF.

AM *Amplitude Modulation.* A method of impressing a signal onto a sine wave for its transmission or storage. A constant frequency sine wave has its amplitude increased or decreased from moment to moment to correspond with the signal. The sine wave, called a carrier, must be of considerably high frequency than any component of the signal. AM radio is an application of this technique. Very simple AM receivers (consisting of little other than a crystal and a coil) can be implemented very easily to receive these signals, although of course more sophisticated circuits can produce higher quality results.

Amp Short for ampere, or for amplifier. In the former sense, the amp is a unit of electrical current. Amps equal volts divided by resistance (or impedance) in ohms.

Amplifier A component or module of a component that increases the amplitude of an electrical signal. Voltage amplifiers and current amplifiers are optimised to provide amplification for specific purposes. See also *power amplifiers* and *preamplifiers*.

Amplitude The level of an electrical signal, usually measured in volts.

Analogue An analogue electrical signal is a facsimile of the item (sound) being represented. For example, when playing an LP record, the analogue audio outputs are represented as electrical 'curves', identical to the musical sound wave pattern you would hear when the record was being recorded. This analogue signal is then amplified and delivered to the speakers. You hear the identical pattern of sound waves from the speakers, except for distortions that creep into the system. There are many people who think analogue reproduction sounds better than digital. It is true that the highest quality analogue replay system is extremely good, but it might be the inherent distortions that produce the 'musicality'. See *Digital*.

Anti-skating a device on a turntable's tonearm to counteract skating. This sometimes consists of an adjustable spring-loaded device near the tonearm's pivot, or weight on a string (where the torque applied by this arrangement remains constant throughout the range of travel).

ATRAC A system for compressing digital audio, using perceptual encoding techniques. This was developed by Sony to allow the full contents of a CD to fit onto a Minidisc, which offers considerably less storage space. In recent years a new version, called ATRAC3, has been introduced which permits greater levels of compression than the original version. This permits ATRAC-based solid state players. The bit rates used by ATRAC3 are 132 and 66 kb/s. The ATRAC compression system also forms the basis of Sony's cinema sound system SDDS.

Audiophile A person who places (or would like to place if circumstances permitted) a high priority on having a home audio system that performs very well, offering a level of reproduction that sounds like the original recorded event to them. As we all listen in different ways and can indeed train ourselves to hear for different 'cues' in music, it is a very subjective issue as to the 'best' system; indeed there is no 'best', just each listener's sense of best.

A-weighting A system of adjusting signal to noise ratio measurements to take into account the differing sensitivity of the human ear to different frequencies. Thus an

A-weighted signal to noise ratio more accurately reflects how a system's noise performance will be perceived than an unweighted measure.

B

Baffle A solid surface surrounding a driver in a loudspeaker. The lower the frequency of the sound produced by the vibrating cone of a driver, the more apt it is to simply cause air to rush from one side of the cone to the other, rather than produce the compression waves that constitute sound. By adding a baffle around the driver, this increases the length of the path that air must travel, lowering the frequency at which this destructive interference takes place. In most loudspeakers, the enclosure forms a baffle. In the case of infinite baffle enclosures, the enclosure is sealed (thus 'infinite') while with bass reflex speakers a port is carefully tuned to allow energy from the back of the cone to supplement that from the front at selected bass frequencies. Put simply, the baffle is the front panel of the loudspeaker.

Balanced An electrical circuit in which both the signal leads (termed positive and negative, or active and neutral) carry equal but inverse signals produced by the source. These require three conductors: two for the signal plus a separate one for shielding. Balanced connections are quite common in high quality (high end) home audio products and in pro-audio, such as in recording studios. Well-designed balanced circuits provide excellent rejection of electrical interference generated in connecting wires and are therefore best used when long signal cables are used, as with multi-room home audio set ups, using analogue signal cables. Balanced connections most often use XLR plugs and sockets.

Band pass filter An electrical circuit that only permits signals between two particular frequencies to pass through. An example is section of a crossover network that allows only the middle frequencies to be delivered to the midrange driver in a loudspeaker. See *low pass filter* and *high pass filter*.

Bandwidth Either the range of frequencies which a component can deal with competently (often specified as the range across which the attenuation is no more than 3dB), or the frequency range required to carry a signal. For example, the bandwidth required for a composite video signal is somewhat more than 5MHz.

Bass Low frequency sounds, typically below around 150 hertz, although the dividing line between bass and midrange is one of opinion. The human ear is less sensitive to bass than to midrange, particularly with regards to location of source,

allowing sub bass units to be placed away from the stereo speakers in 2.1 or 5.1 set ups.

Bass extension An imprecise term concerning how low in frequency a loudspeaker or subwoofer can still operate to produce usable output. A typical bookshelf-sized speaker may manage a bass extension of 80 hertz (say, at -10dB), a good floor standing speaker may manage 30 or 40 hertz, an inexpensive subwoofer 40 hertz, a middling one 25 to 30 hertz, an expensive one 16 hertz.

Bass management A facility in home theatre receivers that permits some of the speakers in a 5.1 channel system to be specified as 'small' rather than 'large'. 'Large' speakers receive the entire signal for their respective channel, but 'small' speakers have the bass stripped off and sent to a subwoofer.

Bass reflex A design for the enclosure of a loudspeaker. With bass reflex speakers the enclosure has a port that permits air to flow between the interior and exterior of the cabinet. The port is a hole, usually backed by a tube. The dimensions of the port are carefully calculated so that it permits bass at a selected frequency to be produced from the interior of the enclosure (driven by the back of the woofer's cone). This arrangement permits a bass reflex speaker to generally achieve greater efficiency than an acoustic suspension speaker, and it extends the depth at which bass may be produced without significant attenuation. However for frequencies below the band produced by the port, the output drops off rapidly.

Belt Sometimes describes the loop of material that is used to transmit rotational energy from motor to record platter on a turntable. Also, a set of 'extreme' audio system tweaks popularized in the 1980s and beyond by Peter Belt in the United Kingdom. Some subjective reviewers have, over the years, sworn by these (and other) measures to improve the perceived sound quality of home audio systems. Many of Peter Belt's ideas do seem ridiculous, but he did much to popularize the notion that audio components and audio rooms can be improved through 'treatment', much of which is unmeasurable, and therefore very subjective.

Beta or Betamax. The first widely-used consumer-level video recording system on the market. Developed by Sony in the late 1970s, it eventually lost out to the rival VHS system, which came to market about a year later, primarily because of shorter playing and recording times.

Bipole A loudspeaker designed to offer well-dispersed sound by firing its high frequencies, and in some models its full frequency range, in two opposing directions. Unlike dipole speakers, the sound is in phase from all the drivers.

Bit The smallest unit of digital information. A single bit can carry just one of two values: 0 or 1. There are eight bits in a byte, 1,024 bytes in a kilobyte, 1,024 kilobytes in a megabyte, 1,024 megabytes in a gigabyte and 1,024 megabytes in a terabyte. Sometimes, though, the traditional 1,000 is used rather than 1,024, leading to confusion. A bit should generally be abbreviated as lower-case 'b' (compared to 'B' for byte). Thus 128kb/s means 128 kilobits per second, whereas 128kB means 128 kilobytes.

Bit depth The size of the number that records each digital sample. Since the system is digital, the number relates to powers of two. The compact disc uses a bit depth of 16, which allows 65,536 different levels to be used to track the analogue source signal. DVDs usually also use 16, but may also use 20 bits (which gives over a million levels) or 24 bits (which gives more than 16.7 million levels). The greater the bit depth, the lower the harmonic distortion and quantization noise, and the more storage space required for the signal. Audio recording studios use 20bit and 24bit, which is reduced down to 16 bit for compact disc. Specialist audio companies are now offering 20 or 24 bit audio for download, this offers super audio CD quality and above.

Bit rate The number of digital bits a system transfers per second. In general, the higher the bit rate, the higher the quality of the signal. In every case, the higher the bit rate, the more data space required. With audio bit rates are measured in the hundreds of kilobits per second (kb/s). With DVD video, they are measured in megabits per second (mb/s).

Bitstream The digital audio output of a DVD player, when switched to outputting the DVD's native digital audio format. Most DVD players can be switched to output a Dolby Digital bitstream, or convert the digital output to PCM.

Blu-ray A high capacity development of the DVD which uses higher frequency (blue) rather than red light frequencies for reading the disc. The combination of shorter wavelengths and other enhancements bumps up the maximum capacity from 8.5GB for a dual layer DVD to around 27GB, allowing the storage of high definition video.

Byte Eight bits. A byte can represent numbers between 0 and 255, or when interpreted as signed integers, between -128 and +127.

C

Cantilever The thin rod within a turntable's cartridge that transmits the movement of the stylus in response to a record's groove to the interior components of the cartridge that generate the electrical signal.

Carrier A sine wave which may be modulated by a signal to form an AM signal. The frequency of the carrier must be significantly higher than that of the modulating signal. In practice, the carrier is usually a radio frequency sine wave, and so is two orders of magnitude higher in frequency than the signal.

Cartridge The device that converts the movements of a stylus in the grooves of an LP record to electrical signals. The cartridge is a small, light-weight device, secured to the end of a turntable's tonearm by means of two screws mounted 12.5mm apart. The movements of the stylus are transmitted through a cantilever to some form of electrical generating device. The two main types of cartridge are ceramic and magnetic. The latter is further subdivided into moving magnet and moving coil types.

CAV *Constant Angular Velocity* – as opposed to CLV. A method of spinning a disc or disk carrying a signal. CAV means that the rate of spin remains unchanged regardless of where the reading device is on the surface. An LP record is an example (which is part of the reason why the outer tracks tend to sound better than the inner ones). While CDs are designed to be operated at a CLV, fast CD-ROM drives actually run them with a CAV.

CBR *Constant bit rate* – as opposed to variable bit rate. The signal (video or audio) is digitally encoded so that a fixed amount of data flows each second. This has the advantage of making the space requirements for the signal easy to calculate. DTS and Dolby Digital are both CBR systems, as are the earlier versions of MPEG audio and video compression. Most MP3 files are CBR encoded, although the format does support VBR as well.

CD *Compact Disc* – 120mm diameter optical disc. It carries a digital PCM representation of a two channel analogue signal, along with error correction information. The analogue signal is sampled at 44,100 hertz and uses a bit depth of 16.

CD emphasis When the compact disc was first developed, the designers implemented a rather surprising element in its specification. This was a pre-emphasis, de-emphasis cycle. In brief, this permits the treble in the source signal to be boosted before the CD is mastered (pre-emphasis), recording this fact by a special bit in the package around each segment of audio data, and cut again by the CD player (de-emphasis). When cut, it also had the advantage of reducing any noise due to the recording medium.

In practice, there is no such noise, so initially it can be hard to see the purpose of this. Then when you consider that for most music the amplitude of the signal reduces as the frequency increases at around 6dB per octave, you can see that the amplitude of the higher frequency components would be very low and, consequently, subject to increased quantization noise. Boosting the higher frequencies significantly reduces this noise accordingly. The frequency response of the signal is pre-emphasised by boosting the signal from 50µs (microseconds – which is what engineers used to specify frequency in some contexts) or 3,183 hertz and levels out at 15µs, or 10,610 hertz, with a maximum boost of 10.45dB. CDs that actually use this are now very rare.

Ceramic cartridge A cartridge that produces an electrical signal through a piezoelectric effect. Such cartridges are rarely used in high fidelity applications because they require a relatively high tracking weight (usually upwards of 10 grams), have a low compliance and produce an uneven frequency response. However they do have the advantage of producing a rather higher output voltage than magnetic cartridges, and their frequency response characteristics approximate the RIAA equalization curve, allowing simpler circuitry to be used with the signal.

Cinch plug Another name, used by companies that presumably don't like to use the opposition's brand name in their own literature, for RCA plug.

Class A A power amplifier in which a sufficient DC bias voltage is applied to the power transistors so that the output signal always operates entirely in the positive or negative part of the cycle, entirely avoiding crossover distortion. This makes them quite wasteful of power since even at idle a considerable voltage is being generated. The DC bias is filtered out before being fed to the speakers. The real benefit of this design is in the sound qualities. Class A designs have no crossover distortion, which is audible.

Class A/B A power amplifier in which a certain amount of DC bias voltage is applied to the power transistors so that, at low power outputs, the output signal operates entirely in the positive or negative part of the cycle, avoiding crossover distortion. Thus, at low outputs, a Class A/B amplifier operates in Class A mode. At higher outputs the signal does cross over the zero point, effectively entering Class B territory. This design is a compromise between the efficiency of Class B amplifiers (in which there is no DC bias) and the elimination of crossover distortion in Class A designs. The DC bias is filtered out before being fed to the speakers.

Class D A very efficient amplifier design. Digital amplifiers use a form of pulse width modulation (with low pass filtering to reduce ultrasonic noise) to drive the loudspeakers. There are some interesting amplifier products appearing that

incorporate class D designs. The jury is out on whether they ultimately offer the same fidelity as more conventional class A/B designs.

Cliff effect Where the degradation of a signal's reception does not gradually increase with a reduction in signal quality or strength, but maintains full quality until some threshold, at which point the signal collapses into incoherence. Analogue transmissions tend to degrade gradually. Digital transmissions in modern systems (with error correction built in) tend to maintain full quality, but then cut out completely at the threshold 'cliff'.

Clipping When the amplitude of a signal reaches some limit determined by the equipment in use, it hits a ceiling (and floor) beyond which it cannot proceed. So the top and bottom of the wave is simply lopped off. The more it attempts to exceed the limit, the more that's chopped off, and the closer to a square wave the formerly rounded wave begins to look. This causes it to generate lots of harmonics, and so it sounds very distorted. The graphic to the right shows a sine wave at the left, and then the same sine wave amplified by just three decibels, to the right. This relatively minor clipping generates a third harmonic of 14%, a fifth harmonic of 3%, a seventh of 1.8% and so on. Truly awful sounding. Clipping is often caused by turning up an amplifier too loud so that its power limits are exceeded.

Clocking signal A signal used to synchronise items of equipment which are communicating digital audio or video signals to each other. The lack of a suitable clocking signal would allow their timing to drift apart from each other, since their internal clocking signals would not be identical, so digital samples would be lost.

The effect when using a very high quality clock in audio components such as CD players, is to produce a high quality sound. The additional costs associated with this means that only the best CD players (and usually the most expensive) implement this in their products.

CLV *Constant Linear Velocity* – as opposed to CAV. A method of spinning a disc or disk carrying a signal. CLV means that the rate of spin varies in order to maintain a constant velocity of the track at the point where the reading device is on the surface. A CD player is an example of this. The CD player runs at about 500rpm at the start of the CD (where the inner grooves are being read), gradually reducing speed to about 200rpm as the track nears the outer edge.

Coaxial Digital The digital audio output signal of a DVD player in an electrical format, rather than optical. The data format accords with the S/PDIF specification.

Codec *Compression/Decompression.* A system which compresses a signal in some way for storage or transportation and then decompresses it at the point of delivery. Examples are MPEG, Dolby Digital and DTS. These systems use a codec to reduce the amount of data in the signal. Other forms of codec, particularly in the days of analogue audio systems, compressed and then decompressed the dynamic range of the signal, not to reduce the size of the signal but to reduce noise levels. One consumer system was called 'dbx'. Digital data storage for audio use several software systems to take complete 16 bit (or higher) files in WAV and compress to nearly half their size. When uncompressed, the files are again identical WAV files. One common compression program is known as FLAC.

Colouration An unwanted alteration in the character of audio. Significant colouration of sound can make instruments and voices sound unrealistic. It may be caused by harmonic distortion, vibrations of component parts (for example, the panels of an inadequately braced loudspeaker enclosure) or, most commonly, through an uneven frequency response.

Compact cassette A neatly packaged magnetic tape recording and playback system for audio introduced in the 1960s. Uses a narrow plastic tape with four tracks running at a speed of 28.6mm/s (1 and 1/8 inches per second). While initially very low in fidelity, in the early 1970s tremendous advances were made in tape formulations, first with Chromium Dioxide magnetic materials and then later with 'Metal' tapes, which extended the high frequency response and improved their saturation characteristics. The addition of Dolby B noise reduction (and later Dolby C) reduced the inherent problem of high noise levels due to the low tape speed.

Compander *Compressor/Expander.* A noise-reduction system that works by compressing the dynamic range of the audio before recording, and expanding it again by an equivalent amount during playback. An example of this was the dbx system.

Compliance The degree of 'springiness' in a mechanical system. For example, the cone of a loudspeaker driver with a soft suspension which can move to and fro relatively easily is more compliant than one with a stiff suspension. The stylus of turntable cartridge with a high compliance tends to follow the excursions of the groove more easily than a that of a cartridge with low compliance.

Component video Three components of a video signal that, together, constitute the full signal. The three components are luminance (Y), red colour difference (CR) and blue colour difference (CB). These can be wrapped into each other to various degrees to form S-Video signals or composite video signals. On DVD the video signal is carried in component video form. The best way to deliver the DVD's

picture to the TV is therefore via either component video connections (in which case, the TV reconstitutes the original RGB signal required for its CRT), or RGB (in this case, the DVD reconstitutes the RGB signal).

Composite video This is the way that the three component video signals are wrapped together to form a single signal, suitable for TV broadcast or carrying on a single two-conductor cable. The two colour difference signals are first matrixed together to form the chroma signal, and then the luminance signal is matrixed into this to create a single composite video signal. This process results in some cross interference between the chroma and luminance portions of the signal, reducing picture quality.

Compression Reduction. Air is compressed by squeezing it into a smaller space. Digital signals are compression by reducing the amount of data space required to hold them. Some digital data compresses readily, due to easily identifiable redundancy within the data. So, for example, a text document typically has a lot of space characters and 'e' characters, so other ways of expressing these can be found. Digital audio and video signal tend not to carry a lot of redundancy, so systems that compress these highly rely on eliminating some of the data and are consequently called lossy compression systems.

Compression driver A kind of loudspeaker driver. Rather than using a speaker cone to directly vibrate the air in a room, a compression driver has a throat in front of the moving part that causes a relatively small amount of air to compress and rarify rapidly in response to the movement of that part. This, in turn, drives the vibration of the air in front of it into the room, through some form of horn. Most compression drivers use piezo effects for the initial vibration, although some use more or less conventional cones. Compression drivers offer significantly higher efficiency than conventional drivers, allowing high output levels for a given input power, but can tend to reduce the dynamic range of the input signal and colour the sound unless, well designed.

Compression ratio The extent to which a signal (particularly digital signals) is compressed, expressed as a ratio of the uncompressed size to the compressed size of the data. MP3, for example, with a bit rate of 128kb/s has a compression ratio of about 11:1.

Constructive interference Where two signals, added together, act in sympathy with each other to boost the signal level. For example, bass from a subwoofer may, at certain frequencies, bounce from a nearby wall and that reflected signal may interfere with bass still coming directly from the subwoofer to effectively increase the output at that frequency. But it is also likely, at other frequencies, to result in destructive interference.

Crossover distortion A small discontinuity (or, at least, nonlinearity) in a signal when a transistor-based amplifier circuit switches from positive to negative operation. This is addressed by Class A and Class A/B designs. Sometimes called 'zero cross distortion'.

Crossover frequency The frequency at which a signal is handed from one component to another. This applies in loudspeaker crossover networks and base management systems.

Crossover network The set of components in a loudspeaker that divides up the incoming signal, sending the bass to the woofer, the treble to the tweeter and, sometimes, the middle frequencies to a midrange driver. The crossover network uses resistors, capacitors and inductors (coils) to divide up the signal. Some systems use active crossover networks. In such cases, the division is made *before* the signal is amplified, so a separate amplifier is required for each driver.

Crosstalk Where a signal (particularly audio) leaks from one channel to another. Thus a voice may be intended to be entirely in the left channel of a stereo recording, but some portion of it appears in the right, dragging the apparent position of the voice somewhat towards the centre of the sound stage. Normally specified by the inverse of crosstalk: separation.

Current The quantity of electrical charge moving through a circuit over a given time. The unit for current is amps or amperes.

D

DAC *Digital to Analogue Converter.* A component, circuit or device that converts a digital signal to an analogue one. Compare ADC which does the reverse.

Damping factor A specification for power amplifiers which suggests the degree of control that the amplifier exercises over a connected loudspeaker. It is the ratio of the nominal impedance of the speaker (and is typically quoted for eight ohms) to the internal impedance of the output stage of the amplifier. A high internal impedance for the amplifier means that its frequency response will vary with real-world speakers since their impedance varies across their frequency range. It also means that the driver, which wants to do its own thing under the influence of air, its suspension and so forth, rather than what the signal is telling it to do, will face a relatively high impedance to the voltage it is generating back into the amplifier. Consequently it will be freer to do its own thing, rather than what the amplifier is telling it to do. However the damping factor quoted for amplifiers does not take

into account the impedance of the wiring between amplifier and loudspeakers, nor the impedance of the speakers' own voice coils. Consequently there is only a modest performance gain between a damping factor of, say, 60 and one of 600.

DAT *Digital Audio Tape.* A compact tape developed in the late 1980s by Sony which stores audio in PCM format. The tapes look very similar to the MiniDV tapes used in digital video cameras, but are somewhat larger, measuring 71mm wide by 53mm deep and 10mm thick. The default format for DAT is a 48 kHz sampling frequency and 16 bits of resolution, but they can also be switched to 44.1kHz.

dB *Decibel.* See *decibel*.

dBFS *Decibel - Full Scale.* The level of a signal, measured in decibels, with reference to the maximum possible level of the signal. With digital audio the maximum recording level is 0dBFS, so all measurements of the signal are negative values.

dB SPL *Decibel - Sound Pressure Level.* A measure of sound intensity. This is a logarithmic measure. To increase the sound level by three decibels, it is necessary to double the power output. A 10dB increase in sound level roughly equates with a perceived doubling of volume level. A figure of around 120-130dB is normally considered to be the threshold of pain. dB is sometimes loosely used as a synonym.

DC *Direct Current.* An electric current that retains its level and direction, at least in the short term. More generally, DC is also used to describe voltage sources that deliver this kind of current. DC is generally used at low voltages within electronic equipment. Batteries deliver DC. Compare with AC.

DCC *Digital compact cassette.* An attempted replacement for the compact cassette introduced by Philips in the late 1980s, early 1990s. This recorded audio in digital format, but used a lossy compression system. It failed to make headway since Sony's Minidisc had the advantage of direct access. More recently, the recordable CD and DVD provides convenient and cheap recording with higher quality.

Decibel Abbreviation dB. A logarithmic measure of ratio. To determine the decibel relationship of, for example, two voltages you use the formula $dB=20*\log(V1/V2)$. If the result is negative, V1 is less than V2. If positive, then V1 is greater than V2. For power the formula is $dB=10*\log(P1/P2)$. dB is often used loosely as shorthand for dB SPL.

Destructive interference Where two signals, added together, act in opposition to each other and reduce the signal level. For example, bass from a subwoofer may, at certain frequencies, bounce from a nearby wall and that reflected signal may, if arriving back out of phase, interfere with bass still coming directly from the subwoofer to effectively reduce the output at that frequency. But it is also likely, at other frequencies, to result in constructive interference.

Digital As opposed to analogue. It is a method of representing real-life signals (which are generally effectively infinitely variable) by using discrete numbers, usually binary numbers (a pattern of 1s and 0s). Holding discrete values, rather than the infinite number of intermediate levels used by analogue, makes digital signals relatively resistant to distortion and noise. The reason is that if any inaccuracy creeps in, unless very severe it will not affect the signal enough to throw it off. Consider a binary system. If all data is represented as either 0 volts or 1 volt, then it doesn't matter if some interference causes the 1 volt level to be sometimes 1.1 volts, sometimes 0.9 volts. The receiving module will regard any voltage as greater than 0.5 volts as 1 volt and treat it accordingly.

Digital audio Any one of a number of systems for recording sound using a digital representation of the sound. Some digital audio systems are straight forward representations of the analogue signal. Examples of these are PCM, DSD and MLP. Other systems take a simple digital signal (usually PCM) and process it heavily to reduce its size. Examples are Dolby Digital, MPEG audio and DTS.

DIN *Deutscher Institut fuer Normung*. A German standards body. DIN frequently appears in specifications to give an indication of how measurements were conducted, and also applies to a number of connectors approved by the body.

Dipole A loudspeaker designed to offer a diffuse, non-directional sound by firing its high frequencies in two directions, out of phase with each other, so that a listener receives few aural clues as to their exact location. To make such speakers work optimally, they should be placed so that the axis running through the front and rear tweeters is at 90 degrees to a line drawn from the speaker to listener. This will maximise the cancellation (see *destructive interference*) of direct radiation from the speaker to the listener's position.

Direct sound field A speaker system in which the great majority of the sound that you hear is coming directly from the loudspeakers, and very little from reflections from surfaces within the listening space. Direct sound field speakers tend to deliver a more accurate reflection of the source, and sharper stereo imaging, than reverberant sound field speakers. Direct sound field sound can be achieved by choosing speakers with restricted dispersion and placing them close to you.

Dispersion The degree to which loudspeakers spread their sound production in all directions, rather than directly to their front. All loudspeakers widely disperse their bass. But as the wavelength of a sound nears the size of a driver's cone diameter, the sound tends to become more directional.

Distortion An inaccuracy in the reproduction of a signal. In the case of audio, it is normally regarded as being composed of harmonic distortion and intermodulation distortion. But used more broadly, it can also encompass frequency response variations and noise. In the case of lossy compression technologies, some distortion consists of spurious noise (not harmonically related) surrounding the signal. When 'distortion' is quoted as a specification without qualification, it normally refers only to harmonic distortion.

Dither Very low level noise, usually 'white' in character, added to a digital audio signal to reduce harmonic distortion. It typically is just a random variation in the least significant bit of the digital signal. In some systems, such as Sony's SBM, the noise is shaped to yield a lower noise floor in the more easily audible midrange and low treble, by pushing much of the noise into the near-ultrasonic.

Dolby Digital Dolby Digital is an encoding scheme invented by Dolby Laboratories as a way of compressing digital audio so that it uses a lot less data space. It is also known as AC-3. Originally developed as an audio compression system for US digital television, it achieved prominence by allowing multiple channel sound tracks to fit onto standard 35mm cinema film prints (in between the sprocket holes on the film!), it has become the de facto standard for DVD. The compression system uses perceptual encoding, similar to DTS, MPEG audio (including MP3) and Sony's SDDS and ATRAC. It can carry up to 5.1 channels of sound, but does not necessarily have that many. Dolby Digital 2.0 (that is, stereo) can be encoded with Dolby Pro Logic surround sound. The Dolby Digital bitstream can also carry codes (metadata) to control playback parameters in the Dolby Digital decoder. Dolby Digital apparently supports bit rates of up to 640kb/s, but on 5.1 (or higher) channel DVDs the bit rates actually used at 384kb/s and 448kb/s. (Note, the 'k' here stands for 1,000, not 1,024). Dolby Digital bitstreams also include metadata for controlling the operation of the decoder.

Dolby Digital EX 6.1 A new surround sound standard which provides the usual 5.1 channels plus an additional channel: the centre rear channel. Unlike DTS ES 6.1 Discrete the additional channel is not carried discretely but is encoded into the two rear channels in a similar way to the front centre channel is encoded into a Dolby Pro Logic sound track. Movies prepared for Dolby EX 6.1 presentation in cinemas should have the same encoding on DVD. However EX 6.1 is compatible with 5.1 channel systems in the same way that Dolby Pro Logic is compatible with stereo systems. More correctly, this should be termed LucasFilm THX 6.1 since

it was developed by them, but the name above seems to have come into common currency.

Dolby HX *Dolby Headroom eXtension*. Not to be confused with the various sorts of Dolby noise reduction, Dolby HX is a process that improves the high frequency, high level recording performance of magnetic tape, particularly compact cassettes.

Dolby noise reduction It was the invention of an effective noise reduction circuit by Ray Dolby in the 1960s that got Dolby Laboratories onto the road to where it is today. This circuit was developed into Dolby Type A noise reduction, which became very widely used for professional analogue recording onto tape, prior to the advent of digital recording. Most analogue recording media produce background noise, typically like white noise. The simple solution would be to boost the middle and upper frequencies during recording, then cut them on playback, thus also cutting the hiss. But this causes overloading problems. Dolby noise reduction systems rely on the masking effect of sounds. If the signal was loud, the hiss would be largely inaudible anyway. So Dolby's system tracked the level of the signal, leaving it unaltered when it was strong, but introducing the boost/cut system when the signal was low. Dolby noise reduction later made it onto consumer equipment in the form of Dolby B, C and S noise reduction systems which all work along similar lines. It was Dolby B, in particular, that allowed the compact cassette to become an established media. Dolby HX, which also appears on recent cassette decks, is not to be confused with the noise reduction systems.

Dolby Pro Logic An improved version of Dolby Surround which decodes two channel Dolby Stereo sound tracks to four channels. In addition to the front left, front right and mono surround channels, it also extracts a front centre channel signal. The use of a centre channel improves the localisation of sound, particularly dialogue, for those viewers not seated directly in front of the screen.

Dolby Pro Logic II A further enhancement of the two-channel based Dolby Pro Logic, this cleverly decodes *separate* left and right surround channels from the original signal and eliminates the 100 to 7,000 hertz bandwidth limitations of the older system.

Dolby Stereo The original name for Dolby Surround, as it was used in cinemas. In cinema usage 'stereo' tended to mean some form of surround sound, although it was usurped by the home entertainment industry to mean two channels at the front of the room.

Dolby Surround The home equivalent of Dolby Stereo. This was the original system for decoding sound tracks for surround sound in the home, usually from video cassette. Dolby Surround sound tracks carry three channels of sound,

matrixed into two channels. The Dolby Surround decoder extracts the additional channel, known as the surround channel, and sends it to a pair of rear or surround speakers. This surround channel is limited in frequency range to 100-7,000 hertz.

Driver The moving part, or parts, of a loudspeaker. These are usually woofers (bass drivers), midrange drivers and tweeters (high frequencies). There are a number of different driver designs. Virtually all woofers use the traditional speaker cone (some light material, often paper pulp or polypropylene) held in place by a suspension and backed by a coil inserted into the magnetic field of a strong permanent magnet. The amplifier's signal is fed into the coil, generating its own magnetic field, causing the coil and the attached cone to move. Midrange drivers, which are relatively rare these days, usually use either cones or domes (often polypropylene or a light metal such as magnesium), although there are some ribbon midrange drivers. Tweeters are most commonly domes (often polypropylene, silk or some other textile, or a light metal such as aluminium or titanium), but cheaper ones use cones. Some use inverted domes (that is, they are concave rather than convex), while some expensive speakers use ribbon tweeters. There was even, for a while, a 'plasma' tweeter where the high frequencies were generated by a pulsating ball of superheated air. Some speakers do not use what could be conventionally called drivers, for example electrostatic speakers.

DRC *Dynamic Range Control.* See *Dynamic Range Control.*

DRM *Digital Rights Management.* A catch-all name for various systems that control the distribution of digital audio and video content. Usually based on secure(-ish) keys and encryption.

DSD *Direct Stream Digital.* The digital audio format used in the SACD. Unlike the PCM system normally used, DSD uses a stream of single bits of information. The momentary level of the analogue wave form being represented by the bitstream is determined by the density with which the bits are 'on' rather than 'off'. It is modified by using noise shaping to increase the effective dynamic range in the main audible band. DSD uses for each channel a bit rate of 2,822,400 bits per second.

DSP *Digital Signal Processor.* A computer-type processing unit optimised to perform 24 or 32 bit floating-point operations on digital audio signals. This allows it to perform Fast Fourier Transforms and other complicated operations in real-time to apply frequency response adjustments, generate reverberation and even split-out certain frequency bands into separate channels. Many home theatre

receivers incorporate DSP programs to generate ambient multichannel sound from stereo sources.

DST *Direct Stream Transfer*. Lossless compressed DSD.

DTS *Digital Theatre System*. A high quality digital surround sound compression format capable of carrying multiple channels of audio. While using perceptual encoding like many other systems, it uses much lower levels of compression. DTS claims that it first uses non-lossy compression techniques to reduce or eliminate the need for perceptual encoding. Many users consider that it produces higher quality sound than Dolby Digital. DTS sound tracks come on DVD encoded at either 768kb/s or 1,536kb/s. (Note, the 'k' here stands for 1,000, not 1,024). The principle advantage of DTS over Dolby Digital is the implementation of DTS in the cinema. Rather than the digital data being optically recorded onto the film itself, DTS audio is recorded on a CD. Special CD players attached to the cinema's film projector keep the audio and film synchronised by means of time sync signals on the film. The advantage lays in the fact that in distributing foreign language sound tracks, only the CD needs to be different for each language, not the film.

DTS 96/24 A variation on DTS. However rather than using DTS's normal 20 bits of resolution and 48kHz sampling frequency (of the PCM data before it is encoded), it uses a 96kHz, 24 bit source signal, offering a theoretical frequency response to in excess of 40,000 hertz. DTS suggests that some of the higher resolution offered by this PCM standard carries through into improved audio quality. DTS 96/24 DVDs are backwards compatible with standard DTS decoders.

DTS ES 6.1 Discrete A 6.1 channel version of DTS where a centre-rear channel is held in a discrete audio channel. DTS ES 6.1 DVDs are backwards compatible with standard DTS decoders.

DTS ES 6.1 Matrix A 6.1 channel version of DTS where a centre-rear channel is encoded into the two normal surround channels in a similar way to that employed by Dolby Pro Logic to hold a centre channel encoded into the two front channels. DTS ES 6.1 DVDs are backwards compatible with standard DTS decoders.

DTS Neo:6 A processing system that endeavours to extract an engaging 6.1 channel surround experience from two channels of audio. Unlike Dolby Pro Logic, this is not an encode/decode system, but more like a DSP system to generate something new.

Dual layer A type of DVD in which there are two physical data layers on the disc. The outermost one is semi-transparent, so a DVD player can focus its laser

through this layer to extract data from the bottom layer. Such a disc has, in single-sided format, a capacity of 8.5GB, rather than the 4.7GB of a single layer DVD.

DVD *Digital Versatile Disc* or *Digital Video Disc*. In the former usage, it is the 12cm optical disc capable of holding masses of data for computer use, video, still pictures or audio.

DVD Audio *Digital Versatile Disc - Audio*. This is the form of DVD which primarily holds DVD Audio material, all of which resides in a folder on the disc called 'AUDIO_TS'. The material may be either PCM or, more commonly, MLP encoded. The DVD Audio material can only be played on a DVD Audio player. DVD Audio discs almost always also hold a repeat of the material in DVD Video format so that they can be used in DVD Video players as well. Typically, though, the audio in this section is recorded in a lower standard of PCM, Dolby Digital or DTS.

DVD-RAM A rewritable (i.e. recorded material can be erased or over-written) recordable DVD. This format is supported by the DVD Forum. It should be noted that DVD-RAM has very limited compatibility with standard DVD players (although recent Panasonic models support it), because it uses significantly different technology to the other types of recordable DVDs. In particular, it offers true random access writing to identified sections of the disc, which has allowed Panasonic DVD recorders to implement a 'time-slip' feature (continuous recording, and the ability to rewind and watch recorded material, even while recording continues). It is also said to support a higher order of magnitude of re-write cycles than either DVD-RW or DVD+RW.

DVD recorder A consumer electronics device which uses one or more of several different types of recordable DVD media as storage for video and audio material. A replacement for the VCR, offering significant improvements in picture quality, plus the usual DVD playback conveniences of fast access, chapter breaks and the like. Most quality DVD recorders are multi-format now, capable of recording to four different kinds of media. Most support only single layer recordable DVDs and thus offer a capacity of 4.7GB, however some are appearing with support for dual layer discs. DVD recorders permit different recording times, with longer times trading off for poorer quality. Very good quality recordings of two hours duration are achievable with a 4.7GB disc, while some offer six or more hours at low quality. Some premium DVD recorders incorporate a computer-style hard disk drive upon which recordings can be made, then edited, before being dubbed (at high speed) to a blank disc.

DVD-RW A rewritable (i.e. recorded material can be erased or over-written) recordable DVD.

DVD+RW A rewritable (i.e. recorded material can be erased or over-written) recordable DVD.

DVD Video *Digital Versatile Disc - Video*. This is the form of DVD which primarily holds DVD Video material, movies or music videos. All the DVD Video material resides in a folder on the disc called 'VIDEO_TS'.

DVD-VR A recording mode offered for DVD-RW discs which differs from the standard DVD-Video mode. It allows significant levels of editing of recordings on the disc, at the cost of very limited compatibility with standard DVD players.

DVD+VR The recording mode provided for DVD+RW and DVD+R discs on consumer DVD recorders. While somewhat different to the standard DVD-Video mode used with commercial discs, it still provides for good compatibility with standard DVD players. On DVD+RW discs it allows significant levels of editing of recordings, while still retaining that good compatibility, and eliminating the need to 'finalise' the disc (DVD+R discs must still be finalised).

DXD *Digital eXtreme Definition*. A PCM-like high-resolution audio encoding scheme for professional editing.

Dynamic power In some respects dynamic power is a similar measure to PMPO, but remains far more realistic. It is quoted in conjunction with continuous power outputs and shows how much power the amplifier or receiver can deliver for a very brief instant, such as when a crescendo is played in music. An amplifier with a reasonably low continuous power output can often sound quite good at reasonably high levels if it has a high dynamic power rating.

Dynamic range The differences in the volume level between the loud bits and the quiet bits of a music replay or sound on a movie. The term is also used as a specification for DVD and CD players. In this sense it means the range between the loudest and the quietest sounds that the player is capable of producing, and is determined by the noise floor of the player and the medium.

Dynamic range control A facility in Dolby Digital to reduce the dynamic range of the audio content in order to allow the entire program to be heard in adverse conditions. It does this by reducing the loudness of the parts of the program which are louder than the level set by the dialog normalization setting, and boosting those parts quieter than that setting. The parameters for reductions are carried in Dolby Digital metadata. This feature is useful for appreciating movies without disturbing neighbours, and when the audio from a DVD is being heard through a limited sound system. In particular, if DRC is available on a DVD player, it should always be switched on if a drivers for higher frequencies. The drivers in some compact subwoofers deliver an excursion of up to 50mm. This wide

excursion is necessary because output level is related to the area of the cone and the excursion. A smaller driver in a subwoofer can only provide equivalent output levels by allowing a greater excursion of the cone. Another example of excursion is the stylus of a cartridge. When playing a stereo LP it moves from side to side and up and down. Each of these is referred to as the excursion (horizontal and vertical) of the stylus.

E

Efficiency Used in connection with transformation of energy from one form to another, efficiency is the ratio of energy output to energy input in the transformation process. In regard to speakers, it is normally expressed as speaker sensitivity.

Electrostatic loudspeakers A form of loudspeaker in which the driver is a panel that responds to a varying electrostatic charge. Such speakers incorporate electronics which convert the moderate voltage, moderate current output from an amplifier into the high voltage, low current signal required to drive the panels. Electrostatic speakers are noted for producing little harmonic distortion and an excellent amount of detail in the reproduction of music. However they often present a difficult load upon amplifiers, can be subject to arcing (producing electrical sparks) in high humidity situations and tend to be somewhat inefficient. Because they use a large panel, these speakers do not employ an enclosure and so are bass limited. For this reason many models are hybrid, with standard woofers in an enclosure for bass. Electrostatic speakers are by their nature dipolar in operation since each side of the panel is generating an out-of-phase sound wave to the other.

Enclosure The box of a loudspeaker. In any half decent speaker, this is not merely a device to keep the drivers off the floor, but an integral part of the design of the whole loudspeaker, contributing greatly to – or, if done badly, detracting from – its performance. The most common enclosure designs are bass reflex and acoustic suspension. Good quality enclosures include strong bracing to resist sympathetic vibrations in their panels, which can lead to sound colouration.

Error correction Redundant data included with a signal in transmission or storage that allows the signal to be reconstructed even if some data has been damaged or lost. Error correction is used in most digital systems, from CDs through to digital television.

EQ Equalization. An adjustment to the frequency response of some piece of equipment or process in order to achieve a desired outcome. It might be part of a standard process (eg.RIAA Equalization) designed to overcome physical limitations, or it might be used to correct unwanted frequency response inaccuracies imposed by a room.

Excursion The degree of fore and aft movement of a mechanical component in an audio system. Loudspeakers, for example, produce sound by vibrating their drivers' cones or domes. The distance between the furthest the cone, say, protrudes forwards and the furthest it moves back into the housing is the excursion of the driver. Woofers tend to have a greater excursion than drivers for higher frequencies. The drivers in some compact subwoofers deliver an excursion of up to 50mm. This wide excursion is necessary because output level is related to the area of the cone and the excursion. A smaller driver in a subwoofer can only provide equivalent output levels by allowing a greater excursion of the cone. Another example of excursion is the stylus of a cartridge. When playing a stereo LP it moves from side to side and up and down. Each of these is referred to as the excursion (horizontal and vertical) of the stylus.

F

FFT *Fast Fourier Transform.* A set of mathematical techniques for deriving a close approximation of the Fourier series for a real-world signal so that processing can be performed upon it. FFT is, with suitable hardware, sufficiently fast to allow real-time processing of signals. DSPs are based upon its mathematics (although, of course, they also do much processing work on the result of the FFT as well).

Firewire Apple Computer's name of a high capacity digital connection standard, capable of delivering up to 400mb/s. Frequently used for transferring video and audio from digital video cameras to DVD recorders and computers. Also known as IEEE1394 (the formal name) and i.link (Sony's name).

Fletcher Munson curves Experimentally derived results which plot the perceived loudness (by humans) of sounds across the audio spectrum. These suggest that our ears are very much more sensitive to midrange and low treble sound than they are to the bass and treble frequency extremes. The peak sensitivity occurs at around 4,000 hertz.

Flutter A defect affecting analogue audio signal sources that rely on rotating the medium, particularly LPs and compact cassettes. Flutter is a rapid, repetitive speed variation, typically repeating at least ten times per second. If an LP or

audio cassette undergoes this, it produces rapid variations in the playback frequency. At the slower end of the scale, it can sound like an unwanted tremolo or vibrato. At higher rates it can add an unpleasant harshness to the sound. Flutter is specified in per cent and specifications of more than around 0.1% are unacceptable. Digital sources such as CDs are immune to flutter because they lock their playback speed to a solid-state timing device.

FM Frequency Modulation. A system of storing or transporting a signal by using it to modulate a carrier in the frequency, rather than amplitude, domain. FM radio, high-fidelity audio on VHS, and numerous other systems are based on FM. FM tends to be more resistant to interference than AM.

Four-way loudspeakers See *4 way loudspeakers*.

Frequency The rate at which a repetitive signal repeats, measured in cycles per second or hertz (or its convenient multiples). Audio frequencies are generally in the range of 20 to 20,000 hertz because those are the frequencies to which the human ear sensibly responds. Equipment measurements often extend this range to 0 to 100,000 hertz. Video frequencies typically deal with a range of 0 to 7 MHz because that is the bandwidth available for PAL and NTSC signals. The human eye responds to light in the frequency range of 385,000 GHz to 789,000 GHz. The frequency of a signal can be calculated by dividing the speed with which the signal propagates through a medium by its wavelength.

Frequency response A measure of how accurately a system reproduces different frequencies. In the case of audio in a home theatre system, it is desirable for the frequency response of a whole system, including speakers and subwoofer, to be from 10 hertz to 20,000 hertz ± 3 dB. This performance requires a very expensive system indeed and, in practice, very few systems will produce bass down to anything like that bottom limit. Manufacturers who claim a frequency response for speakers of, say, 20 to 20,000 hertz without specifying decibel boundaries are telling you nothing. A tinny two inch transistor radio speaker can reproduce that range, although you won't actually hear it at either extreme because its output will be so low. Even subtle variations of less than half a decibel across the audio band can be quite audible, especially if they're spread over a fairly wide band of frequencies, and can thus change the character of the sound. Indeed, with speakers the single measure most closely related to their sound is the frequency response.

Fundamental frequency Any musical tone primarily consists of a particular simple tone (a sine wave) and a series of higher frequency tones, where the frequencies of those higher tones are whole multiples of the first-mentioned tone. The frequency of that simple tone is called the fundamental frequency. When we say

that the Middle C of a piano has a frequency of 261 hertz, we are actually talking about its fundamental frequency, not that of the harmonics without which a piano note would have no distinguishing character.

G

GB *Gigabyte* See *gigabyte*.

Gigahertz A measure of frequency: 1,000,000,000 hertz.

GHz *Gigahertz* See *gigahertz*.

Gigabyte A measure of memory storage, a gigabyte equals (i.e. $1,024 \times 1,024 \times 1,024$ or 2^{30}) bytes, 1,048,576 (i.e. $1,024 \times 1,024$ or 2^{20}) kilobytes or 1,024 megabytes. However, if used as a measure of hard disk storage, the 'giga' prefix normally means a round billion.

Group The major divisions for content on a DVD Audio disc. Typically the surround sound mix is in a different group to the stereo mix, while bonus video clips are in a separate group. This is the equivalent of a Title on a DVD Video. A Group is normally subdivided into Tracks.

H

Harmonic A tone the frequency of which is a whole multiple of another tone with which it is associated. Virtually all physical sound producers (including, unfortunately, loudspeakers) produce complex sounds which consist of a fundamental tone and many harmonics. Harmonics are also known (more in musical, than home entertainment, contexts) as overtones.

Harmonic distortion When a signal (usually audio) is not reproduced perfectly, it is said to be distorted. Harmonic distortion is a specific, and common, type of distortion in which a given frequency that is supposed to be in the signal has added to it overtones, or additional unwanted signals which are whole multiples of its original frequency (harmonics). Equipment suppliers often quote a measurement called THD or Total Harmonic Distortion. The lower the figure the better in general. But relatively high levels of evenly numbered harmonics are easier to tolerate – indeed, can often be attractive, making the sound 'warmer' – than quite low levels of odd order harmonics.

Hass Effect Also known as the Precedence Effect. The human ears do not rely solely on different loudness's to determine the direction from which a sound is coming; they also use timing. It is often the case that timing trumps loudness. If the same sound arrives from two different directions, the ear will tend to identify the direction of the source as that of the first sound to arrive, even if the other sound, arriving a few milliseconds later, is significantly louder. This is why it is important to properly adjust the time alignment of surround speaker systems. This effect is also made use of in high quality sound reinforcement systems in concert halls, since by delaying the sound coming from speakers near the back of the hall, it can be made to sound as though the high volume coming from those reinforcing speakers is actually coming from the front of the hall.

HD CD *High Definition Compatible Digital.* An encoding/decoding system intended to improve the resolution of CDs (and other digital audio sources) while retaining full CD compatibility. It is said to provide performance equivalent to a PCM system with a resolution of 20 bits, whilst retaining CD's bit depth of 16 bits.

HDCP *High-bandwidth Digital Content Protection.* An encryption protocol developed by Intel and accepted for DVD use by the DVD Forum. This encrypts digital video output in real-time solely for the purpose of decrypting at the other end of a DVI or HDMI cable. It provides for two DVI-equipped devices to conduct a handshake, establish an encryption key, and then feed the video signal at full resolution in uncompressed digital format. HDCP supports high definition video signals as well. This system is supposed to protect against high quality digital video copying.

HDMI *High-Definition Multimedia Interface.* A new connection standard for feeding signals from sources to output devices in digital format. This carries both uncompressed digital video (in a form compatible with DVI) and uncompressed digital audio. Suitable encryption protocols are implemented on both (that for the video is HDCP) to resist digital copying. It has a huge bandwidth (up to 5 gigabits per second) allowing it to carry even 1080i video and, at the same time, up to eight channels of 24 bit, 192kHz digital audio. Plus it handles interaction between equipment, easing the way towards true single-remote-control of all devices. From a user perspective, though, it will mean that a DVD player need be connected to a home theatre receiver with just one cable (rather than the up to twelve currently: analogue audio x 6, digital audio x 1, component video x 3, S-Video x 1, composite video x 1). The receiver will then, presumably, provide a DVI output to on-forward the video to the display device.

HDTV *High Definition Television.* Offers resolutions of 720 or 1080 lines compared to the 480 or 576 visible lines of analogue or Standard Definition Television (SDTV). Three HDTV formats are currently on the market - 720p,

1080i and 1080p. 720p has a resolution of 1280 lines by 720 vertical lines and 1080i and 1080p of 1920 by 1080. 720p displays each frame in full (progressively), while 1080i, displays each frame as one of two interlaced fields. Most High Definition screens will scale whatever source they are fed to fit the screen but will look their best when fed a source at their native resolution.

In parallel to the introduction of HDTV, two new High Definition DVD formats have been introduced, HD-DVD and Blu-ray (now the dominant format). Microsoft's Xbox 360 gaming console is HD compatible with an optional HD DVD drive. Sony's PlayStation 3 comes equipped with a Blu-ray drive as standard. HD camcorders are also becoming available.

Hertz Cycles per second – a measure of frequency. Young healthy humans can hear from around 20 hertz to around 20,000. Frequencies lower than that can often be detected by other parts of the body.

Hi-Fi *High Fidelity*. This is a tricky set of four letters. 'Hi-Fi' is frequently used a generic noun for any stereo sound system. But it should more properly be regarded as an adjective, taking due note of the Latin roots of the word fidelity, which means 'truth'.

Originally high fidelity described a sound reproduction system that gave a more accurate rendition of the recording than was commonly available. The greater the accuracy, the higher the fidelity. In absolute terms, the term changes over time - as audio systems improve, so do those properly described as 'high fidelity'. A very fine high fidelity system from 1970 would not qualify for the term today.

High pass filter An electrical circuit that impedes signals below a particular frequency. In other words, it lets signals above that frequency pass through. An example is the circuit in a home theatre receiver that stops deep bass from going to a centre channel speaker. Compare low pass filter and band pass filter.

Home theatre receiver A multi-channel amplifier with a digital decoder and tuner built in. The decoder always provides at least PCM and Dolby Digital decoding, and almost always DTS as well. A few also incorporate MPEG audio decoding.

Horn loaded driver A loudspeaker driver in which a horn is placed over the front of the driver. The primary advantage of this is to increase the efficiency of the transfer of mechanical energy from the driver to the air. However it usually results in reduced dispersion of sound, particularly for higher frequencies which tend to be 'beamed' from the horn, and can colour the sound. Nevertheless, some speaker makers have specialised in using horns, especially Klipsch, and they are frequently used in professional sound-reinforcement installations. The increase in efficiency can be quite marked. Klipsch loudspeakers tend to offer

around nine decibels higher output than equivalent non-horn loaded loudspeakers, which means they can produce the same output from just one eighth of the power required for conventional speakers. This can, in turn, mean lower harmonic distortion because driver excursion is significantly reduced.

Hybrid discs Optical discs which provide more than one format. Many SACDs are hybrid, consisting of two layers. One layer carries SACD-only audio while the other carries CD-only audio, providing considerable versatility for these discs. Most DVD Audio discs are hybrid in the sense of carrying material suitable for both DVD Audio and DVD Video players. However with most of these the capability is provided by logical organization rather than physically separate layers or the like. Recently there have been experiments conducted with providing hybrid DVD/CDs, with the DVD material on one side and the CD material on the other.

Hybrid loudspeakers Loudspeakers in which two significantly different driver technologies are used. For example, loudspeakers which use electrostatic panels for midrange and treble combined with conventional bass drivers, or ribbon tweeters combined with conventional bass drivers.

Hz Hertz See *hertz*.

I

IEC International Electro-technical Commission - a standards body whose standards include those for SPDIF.

IEEE1394 The formal name of a high capacity digital connection standard, capable of delivering up to 400mb/s. Frequently used for transferring video and audio from digital video cameras to DVD recorders and computers. Also known as Firewire (Apple Computer's name) and i.link (Sony's name).

i.link Sony's name for a high capacity digital connection standard, capable of delivering up to 400mb/s. Frequently used for transferring video and audio from digital video cameras to DVD recorders and computers. Also known as Firewire (Apple Computer's name) and IEEE1394 (the formal name).

Imaging The sensation produced in a stereo or surround system of sounds coming from between, behind and/or in front of the loudspeakers. The imaging is described in various subjective ways relating to how tightly focused those sounds appear, whether they seem to offer a fore-aft depth, whether they give an impression of height as well as width and depth.

Impedance A measure of electrical resistance and reactance. These are the properties of a component that limit the amount of current that can flow through a circuit. Resistance affects the DC part of the electrical current, while reactance affects the AC part. Measured in ohms.

Infinite baffle Another term for acoustic suspension. The term is descriptive, in that if the baffle of a loudspeaker were to be infinitely extended in all directions, there could be no movement of air between the front and back of the driver. Of course, with a real infinite baffle speaker the baffle is wrapped around into a convenient package.

Infrasonic Audio tones of frequencies lower than capable of being detected by the human ear, generally below 20 hertz.

Interconnect The cables used to transfer an analogue line level, or digital signal from a source component to an amplifier or recording device. They are normally two sets of electrically shielded cables with RCA plugs on each end, however some systems have adopted the XLR plugs and sockets used in much professional equipment.

Integrated amplifier An amplifier consisting of both a preamplifier and a power amplifier. If properly designed, an integrated amplifier should offer better sound qualities, due to less connectors and cables between components. It is still the case however, that most of the high end amplifiers are offered as two boxes, generally because the amount of electronics in each make it difficult to build a sensible one box solution. There are exceptions to this, and we would direct you to our own AT2000 integrated amplifier in this instance.

Intermodulation Distortion If two tones are produced at the same time as each other, they can interact in a piece of equipment to produce other tones. Those tones are the sum and difference between the two original tones and, consequently, are generally not harmonics of either tone. As such, intermodulation distortion is generally more audible, and objectionable, than harmonic distortion. If the standard SMPTE test tones are applied (60 hertz and 7,000 hertz sine waves), then you can expect to see intermodulation distortion peaks at 6,940 and 7,060 hertz. In practice, small levels of harmonic distortion in the original signals will lead to other IM peaks, so you might see one at 6,880 hertz (i.e. $7,000 - 2 \times 60$) and so on.

J, K

Jack plug, jack or TRS connector. Familiar from the larger type of headphone jacks (or plugs), these are widely used in professional audio as well. There are three common sizes, 6.4mm, 3.5mm and 2.5mm. They come in both mono (two conductors) and stereo (three conductors) versions. The latter type at 6.4mm size are often wired for balanced mono operation in pro-audio applications where XLR plugs/sockets are not appropriate.

Jitter The phenomenon of a drift in the digital audio data delivered so that it does not precisely match the sampling frequency, causing confusion in the receiving equipment as to the appropriate value of the sample. A host of audible problems with CDs and other digital formats have been laid at the feet of jitter. There is no doubt that very precise master and upsampling clocks can help to make CD players sound better.

kB *Kilobyte*. A measure of memory storage, a kilobyte equals 1,024 (i.e. 2^{10}) bytes.

kb/s or *kbps* – *Kilobits per second*. A measure of the data flow rate for digital audio from a DVD. Stands for thousands of bits per second. Generally, the higher the number the better the quality.

kHz *Kilohertz*. A measure of frequency: 1,000 hertz.

L

LCD *Liquid Crystal Display*. Screen type, increasingly being used for large direct view panel displays as well as touch screens for home A/V use.

LFE *Low Frequency Effects* channel, sometimes imprecisely known as the subwoofer channel. This carries audio information covering frequencies up to 120 hertz and is designed to provide a substantial foundation to the bomb blasts, rumbling trucks and the like in movies.

Linearity In any home entertainment system, at each stage the input and output signals should be precisely proportional to each other (except where specifically provided such as RIAA equalization or Dolby noise reduction). Thus if a momentary 0.5 volts is fed to the input of an amplifier and it produced a three volt output at its speaker terminals, then a momentary 1.0 volt input should produce a six volt output. Any other output means that there is a non-linearity which will manifest itself as harmonic distortion. Another example relates to digital to analogue converters. Each particular quantization level in a PCM digital signal has a precise analogue voltage level associated with it. Any variation means distortion.

Line level An electrical signal at a voltage level suitable for transferring a signal between components of a home entertainment system (for example, CD player to amplifier, amplifier to VCR). Most modern equipment operates with a maximum of level of not much more than two volts RMS. Line level signals demand high impedance inputs. At least 10,000 ohms is suitable, although the de facto standard is 47,000 ohms.

Loudness control An unnecessary circuit on a preamplifier, that boosts the bass and, to a lesser extent, the treble of an audio signal. The idea was to overcome the reduced sensitivity of the ear to bass and treble at low volumes, but in fact this could only be achieved with any degree of realism by providing a complex means of calibration, which was never actually provided.

Loudspeaker A device for transforming electrical energy into acoustic energy (i.e. vibrations in the air). A loudspeaker normally consists of one or more drivers, a crossover network and an enclosure.

Low pass filter An electrical circuit that impedes signals above a particular frequency. In other words, it lets signals below that frequency pass through. An example is the circuit in a home theatre receiver that allows bass frequencies to go to a subwoofer. Compare high pass filter and bandpass filter.

LP *Long Play* record. The vinyl record that was introduced in the early 1950s to replace the shorter-play records previously used. Rather than their 78 rpm rotational velocity, the LP rotated at 33 1/3 rpm and used narrower grooves. Accordingly, it gave a playing time of between 15 and 30 minutes per side, depending on the how heavily the signal was modulated, the amount and character of its bass content and the amount of material available.

LPCM *Linear Pulse Code Modulation*. For all practical purposes, the same as PCM. This tends to be called LPCM when dealing with DVDs.

LSB *Least Significant Bit*. The bit of the binary number that varies the value of the binary number by no more than one (which is why it is the least significant). This bit is often randomised in PCM digital audio in order to add dither to the signal.

M

Magnetic cartridge A turntable cartridge that produces the signal by moving a magnet within a coil (moving magnet cartridge), or vice versa (moving coil cartridge).

MB Megabyte. A measure of memory storage, a megabyte equals 1,024 kilobytes or 1,048,576 bytes. However, if used as a measure of hard disk storage, the 'mega' prefix normally means a round million.

Mb/s or Mbps – Megabits per second. A measure of the data flow rate for digital video from a DVD. Stands for millions of bits per second. Generally, the higher the number the better the quality.

MC cartridge *Moving Coil cartridge.* See *Moving coil cartridge.*

Memory stick A small, removable flash memory (i.e. non-volatile) cartridge developed by Sony, used in a host of digital storage situations including audio.

Metadata A set of 'flags', or predefined digital bits, carried in a Dolby Digital bitstream that provide instructions to the decoder. They do not carry actual audio data, but guide the decoder in the interpretation of the audio data or call up visual material to support audio on Music Servers and such like.

MHz Megahertz. A measure of frequency: 1,000,000 hertz.

Midrange The audible frequencies typically constituted by frequencies of between 150 and 5,000 hertz, although the dividing lines between midrange and bass at the bottom end, and midrange and treble at the top end, are ones of opinion. The human ear is most sensitive to midrange frequencies.

Midrange driver A middle-sized driver designed to reproduce the important midrange frequencies between the bass and treble notes. If this is omitted, the loudspeaker is called 'two-way'. If present, along with a woofer and a tweeter, it's called 'three-way'. Some loudspeakers use a midrange driver that looks identical to the two or more woofers in the speaker box. However these drivers are usually tuned differently.

Minidisc A digital audio music delivery system using a disc mounted inside a small, robust plastic cartridge. The audio is encoded using ATRAC. Interestingly, the audio may be carried on the disc in two different ways. Sony designed it both for acting as a recorder, and playing back commercially-produced Minidiscs. So in the former role it acts as a magneto-optical recorder. For the latter, it uses discs which have been pressed in a similar manner to commercial CDs.

MLP Meridian Lossless Packing. A digital audio standard used for DVD Audio. Also known as Packed PCM or PPCM. This provides quality sound, from mono through to multichannel, with a number of technical advantages over Dolby Digital and DTS. The middle word, 'Lossless', is important. It is not a perceptual encoding system that abandons some of the original source material to achieve

space savings. It preserves the original signal perfectly, even through multiple encoding/decoding cycles.

MMC *Multimedia Card*. A small, removable flash memory (i.e. non-volatile) cartridge.

MM cartridge *Moving Magnet cartridge*. See *Moving magnet cartridge*.

Mono or Monophonic. Where just a single channel carries all the sound. Even if played back on a system with two or more speakers, the sound remains mono because the left and right front speakers are delivering identical signals. Contrast with stereo and surround sound.

Moving coil cartridge A magnetic cartridge in which the stylus moves a coil via the cantilever, while the magnet is fixed in position. Moving coil cartridges tend to have lower moving mass than moving magnet cartridges, but also tend to be lower in output by an order of magnitude. There are, however, high output MC cartridges available that produce comparable levels to MM cartridges. Because the coil must be wired to the outputs, they also tend to be somewhat lower in compliance than MM cartridges, so are not normally amenable to very low tracking weights (they typically operate best at around two grams). The sound qualities are generally thought to be better than any other cartridge type.

Moving magnet cartridge A magnetic cartridge in which the stylus moves a magnet via the cantilever, while the coil is fixed in position. Moving magnet cartridges tend to have a higher output than moving coil cartridges, but also tend to have a higher moving mass (possibly reducing their ability to deliver fine detail from record). Because the magnet is able to freely move, MM cartridges generally offer a higher compliance than MC cartridges, so the cartridges with the very lowest tracking weights (0.75 to 1 gram) come from the MM camp.

MP3 *MPEG 1 Layer 3*. This is a digital audio compression standard that achieves high levels of compression of mono or stereo sound through perceptual encoding techniques. MP3 encoded music listened to through a decent Hi-Fi system will quickly show that, whilst claims are made as to 'close to CD quality sound at the highest encoding rate' the removal of music data does reduce the quality. Good for Internet music transportation and small portable solid-state players. MP3 supports bit rates of 8 to 320 kb/s.

MPEG *Motion Picture Experts Group*. In practice, this stands for a number of audio and video compression standards. The video on DVDs is compressed according to the MPEG-2 standard, which permits not only compression of each single frame of the picture, but higher levels of compression by comparing frames with each other and only encoding their differences. MPEG audio also appears on

some DVDs. This permits up to 7.1 channels of audio to be encoded, although only 5.1 channels is ever seen in practice and 7.1 is now obsolete. MP3 is one particular form of MPEG stereo.

Multichannel sound Often called surround sound. Any system designed to deliver more than two channels (stereo) of sound to the consumer. The most common forms these days deliver 5.1 channels of audio. Some systems can process two channels, or even one channel, of sound to produce the effect of multi-channel sound.

N, O

Noise shaping A system of adding dither noise to a digital audio signal so that it is biased towards high frequency noise. This permits the noise floor to be lower in the range of frequencies to which the ear is most sensitive, at the cost of poorer noise performance in the higher frequencies where the ear is less sensitive.

Nominal impedance A specification of the load a loudspeaker places on an amplifier, measured in ohms. It tends to oversimplify the actual situation because the impedance of a loudspeaker varies according to frequency. So a speaker with a nominal impedance of eight ohms may actually present a load of six ohms at some frequencies and thirty ohms at others. Common loudspeaker impedances are four, six and eight ohms. Back in the 1960s, higher impedance speakers – 16 and 32 ohms – were fairly common.

Octave A range of frequencies of some form of repetitive wave, where the highest frequency is precisely twice the lowest frequency. In music, for example, the fundamental frequency of A below Middle C is 220 hertz. The A above Middle C is 440 hertz.

Ohm A unit of electrical resistance or impedance. In a DC circuit, the number of ohms of resistance offered by a component can be calculated by dividing the voltage across the component by the current (in amps) flowing through it.

Optical digital A method of communicating digital audio between components using light carried on optical fibre. See *TOSLink*. The data format accords with the S/PDIF specification.

Optical soundtrack The traditional medium for carrying a film's soundtrack. The sound was converted to markings which were developed onto the edge of the film. The majority of optical soundtracks were analogue (in the form of squiggly lines, like the track on an LP). However Dolby Digital is also carried on the film in optical

form. Rather than replacing the analogue soundtrack (which is left on for broad compatibility), the Dolby Digital data is optically recorded between the sprocket holes on the edge of the film.

OSD *On Screen Display*. The menus and information screens shown by TVs, DVD players, VCRs and some home theatre receivers on the TV screen. These make setting up these devices somewhat easier than those devices that lack them.

Overtone See *harmonic*.

P

Passive loudspeaker A loudspeaker without built-in amplification for all the drivers. Most domestic Hi-Fi loudspeakers are passive, not active.

Passive subwoofer A subwoofer without built-in amplification. Most subwoofers are active, not passive.

PCM *Pulse Code Modulation*. This is standard, uncompressed digital audio of the kind that is on compact discs. However while normal CDs are always encoded with 16 bits and 44,100 hertz sampling rate, on DVD bit depths of up to 24 and sampling rates of up to 96,000 are permitted.

Perceptual encoding A compression technique for digitally recorded sound. Digital audio does not compress at all well using conventional 'non-lossy' schemes because there is very little redundancy in the data stream. Perceptual encoding techniques rely on extensive psycho-acoustic analyses of how the human ear and brain detect and interpret sound. In essence they manage to achieve high levels of compression by discarding elements of the sound that such analyses suggest cannot be heard. In this way they can reduce the data volume of the sound by a factor of 10 or more without obviously degrading the sound quality. Examples of perceptual encoding compression systems are Dolby Digital, DTS (although DTS claims that it first uses non-lossy compression techniques to reduce or eliminate the need for perceptual encoding), MP3, SDDS, Windows Media, RealAudio and ATRAC.

Phase The alignment or otherwise of two signals in time. 'In phase' means that they are aligned 'Out of phase' means that one or the other is shifted in time by one half the period (inverse of frequency) of the tone in question. If an out of phase pair are played together, they will cancel each other out. Phase is usually measured in degrees. A zero degree shift is in phase, while a 180 degree shift is

out of phase. Causes of phase shift include filters (especially those in loudspeaker crossover networks) and the (lack of) time alignment of drivers in a loudspeaker.

Phono From phonogram. An adjective relating to systems for playing vinyl recordings, such as LPs. Thus the phono input of an amplifier is the input into which a turntable is plugged. This is usually equipped with an RIAA equalization circuit. RCA plugs and sockets are sometimes called 'phono' plugs/sockets in the UK.

Phonogram An old name for a record player, that is, a combined system with turntable, amplifier and speakers, usually all contained in one cabinet.

Pink noise Random audio noise where the average amount of power is the same for each octave. The power level of pink noise falls away by three decibels for each increasing octave. Frequently used as a test signal, it more accurately reflects the energy content of real-world audio than white noise.

Plasma display A flat panel display technology which consists of three tiny cells for each pixel. Each cell contains a gas which, when electrically stimulated, emits ultraviolet light which, in turn, activates a phosphor coating on the edge of the cell facing the viewers.

PMPO *Peak Music Power Output*. This is a 'fairyland' measure of power output, sometimes quoted for home stereo systems and should be ignored.

Port The hole in the enclosure of a bass reflex loudspeaker.

Power The amount of energy expended per unit time. The common unit is the watt. Power (in watts) in a DC circuit equals voltage times current (in amps). Things are a bit more complicated with AC.

Power amplifier A device that increases a line level signal (typically around two volts into a high impedance) and boosts it in voltage, while allowing sufficient current to be supplied to drive low impedance loudspeakers (that is, impedances nominally in the four to eight ohm range). Most power amplifiers are analogue in design and use transistors or valves, or a combination of both. New digital amplifiers are appearing which effectively use a form of pulse width modulation, low pass filtered to reduce the ultrasonic noise, to drive the loudspeakers.

Power supply All active audio products require a power supply, the section that provides a suitable voltage and current for the operation of the device. This typically consists of a transformer, rectifier (to turn AC into DC) and regulator (to smooth out fluctuations in the voltage). Power amplifiers in particular are heavily dependent upon the quality of their power supplies, which contribute a significant proportion of their cost and weight. Of the transformer regulated supply designs,

the Never Connected power supply is perhaps the best design available, offering a high degree of isolation from the 'dirty' mains. Switch mode power supplies are used in some audio applications but they tend to inject noise into the signal path and are not favoured by most audio product designers.

PSP Pit Signal Processing - a digital watermark feature used on SA-CD.

Pre-amplifier Nominally this boosts a low level signal to a level suitable for delivering to a power amplifier, but in these days of fairly high output source components (such as CD players), their main function is to provide a volume control and switch between different sources. Some pre-amplifiers may incorporate such things as loudness and tone controls and mute buttons. Some pre-amplifiers also incorporate a phono preamplifier which boosts the low level signal (say 5 to 100 millivolts) of a phono cartridge's output and applies RIAA equalization, but these tend to be of low quality.

Q, R

Quantization The numerical value assigned to a particular analogue voltage input at an instant of time in an analogue to digital converter, or the process of making such an assignment. The range of numerical values available, and consequently the accuracy of the assignment, depends on the bit depth of the PCM system employed.

Quantization noise A form of harmonic distortion produced in all digital systems. Low level signals do not use all the bits available in the digital system (that's why they are low level signals!) Consequently they operate as though the digital system has a low bit depth (say, an eight bit system or even four). This increases their harmonic distortion. By its nature, harmonic distortion generated by digital systems tends to give relatively high levels of odd-order harmonics, which are far more irritating than the even order harmonics to which analogue systems tend. This is routinely addressed by adding dither to digital signals.

Red book See *RBCD*.

RBCD Red Book CD - the original Compact Disc Digital Audio standard that defines regular audio CDs.

RCA plug/socket Also known as a 'phono' connector in the UK. Perhaps the most common audio and video connection standard. They are used for standard audio connections, as well as composite video, component video (three of them in this case) and digital connections.

Reactance The aspect of impedance which varies according to the frequency of the signal it is affecting. Measured in ohms.

Receiver In the stereo world, an amplifier with a tuner built in. Often used as short hand for home theatre receiver.

Region Code A system built into DVDs that is intended to prevent the playback of DVDs from one part of the world in DVD players sold in another part of the world. There are six region codes. The United States is Region 1. Europe and Japan are Region 2.

Resistance The aspect of impedance which remains constant regardless of the frequency of the signal it is affecting. In the case of DC voltages, the resistance is the same as the impedance. Measured in ohms.

Resolution The amount of detail a system is capable of recording or producing. For digital audio, it is largely determined by the bit depth.

Resonant frequency The frequency at which a system offers the lowest impedance, allowing the highest power transfer. In the case of physical systems, it is the frequency at which the vibration is greatest for a given input. For loudspeaker drivers, the resonant frequencies of the drivers are very important characteristics to take into account in the design process, avoiding placing them in the range of operation for higher frequency drivers, and carefully designing the enclosure to make best use of the resonant frequency of the woofer.

Reverberant sound field A speaker system in which a significant amount, perhaps most, of the sound that you hear is coming from reflections from surfaces within the listening space rather than directly from the loudspeakers. Reverberant sound field speakers tend to have a larger sweet spot, and produce a more rounded stereo image with greater depth than direct sound field speakers. Reverberant sound field sound can be achieved by choosing speakers with a very wide dispersion, such as bipole speakers.

RIAA Equalization *Record Industry Association of America Equalization.* When converting an electrical signal to mechanical motion, there is an inconvenient fact: the lower the frequency, the higher the excursion of the moving part for a given signal level. This is important in several fields, particularly with LPs. The grooves of an LP would wobble very widely if the bass frequencies were cut in direct proportion to the signal. The playing time would, consequently, be very short and turntables would have a great deal of difficulty in holding their styli in place within the groove. So before LPs are cut, the signal is subjected to RIAA equalization. This reduces the bass by an enormous amount (-17dB at 50 hertz), and increases the treble equally hugely (+13dB at 10,000 hertz). A circuit built into

the phono preamplifier of the playback equipment reverses this EQ, boosting the bass back to its proper level and handily cutting the treble. This last has the welcome effect of substantially reducing the hiss produced by the scraping of the stylus within the groove. Note: old-style ceramic cartridges did not require this second step of reversing the EQ because their frequency response characteristics roughly approximated this anyway.

RMS *Root Mean Square.* A measure of voltage or (incorrectly) power output. The latter is often quoted in the specifications for an amplifier or home theatre receiver. Measuring voltage is simple with direct current, even if it varies in level. You can simply average the values over time. But alternating current, when arithmetically averaged, gives you a value of zero or close to zero. If you square each value (multiply it by itself) before taking the average, and then take the square root of that average, you not only get a reasonable representation of the voltage, but a value that provides effectively the same amount of power as a similar DC voltage into a resistive load. What is called 'RMS power output' for amplifiers is calculated using the RMS voltage delivered by the amplifier to test loads, so in that sense the term is not entirely misleading (however something like 'average sine wave power output' is far less irritating). Such figures should include a measure for the amount of distortion generated at that power. This should be well under 0.5%. If the figure is 10% (often used with home entertainment systems) the figure should be discounted substantially.

Rumble Low frequency noise, usually from a turntable. Given that RIAA equalization boosts the bass signal from a cartridge by an enormous amount (17dB at 50 hertz), the highest quality bearings and excellent isolation from the turntable's motor are required to control rumble.

Running in An often recommended process for the installation of new Hi-Fi equipment. Essentially, running in is operating the new equipment for some hours, or tens, or hundreds of hours, to bring it up to peak performance. Loudspeakers are physical systems with suspensions and surrounds that do definitely benefit from being run in. Running in cables does seem to improve their performance, and it is certainly true that capacitors and some other components in electrical circuits sound 'better' when run in for some time. None of this is measurable and there are sceptics who say this is all baloney. Use your own ears to decide!

S

SACD *Super Audio CD*. An audio format developed by Sony and Philips to take on DVD Audio. Both formats are being superceded by 20 and 24 bit music downloads and bluray now.

Sample One from a series of digital measurements taken of an analogue signal at regular intervals. The timing of the intervals is determined by the sampling frequency. The accuracy of the sample is determined by the sample's bit depth and the quality of the ADC.

Sampling frequency The number of digital samples taken each second of an analogue audio signal. For the compact disc, this is always 44,100 samples per second (usually expressed as hertz). For DVD it is typically 48,000 hertz, but may be 96,000. The higher the figure, the more accurately the analogue source is recorded, giving an extended high frequency response, and the more space the signal requires.

Satellite speakers Small loudspeakers designed to deliver only midrange and high frequency audio. They are intended to operate in conjunction with a subwoofer which delivers the bass.

SBM *Super Bit Mapped*. An analogue to digital conversion system developed by Sony that incorporates a form of noise shaping, designed to deliver very good performance results in the middle frequencies, at the cost of a poor signal to noise ratio in the high frequencies.

SCART *Syndicat francais des Constructeurs d'Appareils Radio et Television*. A large connector, carrying 21 pins, designed to connect VCRs and DVDs to TVs. Convenient but superceded by much better cable alternatives offering higher fidelity A/V.

Sensitivity A measure of the efficiency with which loudspeakers turn the electrical energy provided by a power amplifier into acoustic energy. The more sensitive, the greater the volume for a given amount of power. This is normally measured as the sound pressure level in decibels (dB SPL) achieved by the loudspeaker in an anechoic chamber at a distance of one metre with a 2.83 volt 1kHz signal applied (2.83 volts is the voltage required to deliver one watt to an eight ohm load.) Sensitivities generally range from not much more than 80dB up to 100dB. Each 3dB increase in sensitivity is equivalent to doubling the amount of power, so for a loud system it is far better to choose sensitive loudspeakers rather than pay for a higher-powered amplifier.

Separation A measure of the degree to which leakage from one channel of sound to another channel (crosstalk) is limited. This is typically measured in decibels (e.g. -90dB at 1kHz). While great emphasis is placed on this figure, the reality is

that very modest figures like -20 or -30dB (typical of LP records) provide excellent stereo separation and imaging. More important is that the separation should not vary widely between different frequencies, since this could lead to a positioning mismatch between the fundamental and harmonic frequencies for particular instruments.

Server (music) A computer device dedicated to the storage and analogue production of music from its library held in digital form on its hard disk. There are many variations of server available for audio, from dedicated software enabling any home computer to 'serve' music, to dedicated hardware and software products offering the highest level of audio replay.

Shielding A finely woven mesh of thin wires, or a conductive foil wrapping, around a signal cable under the outer layer of insulation, or solid in the case of transformer shielding. The shielding is earthed and acts to protect the signal-carrying wires within from electrical fields which could introduce noise into the signal.

Signal to noise ratio A specification for the level of noise produced by a system. This is normally expressed in the decibel difference between the measured noise and some reference signal.

Sine wave An electrical signal or tone that follows a sinusoidal shape. The shape is ubiquitous in nature. All repeating waves can be generated by a combination of a sine wave with various harmonics of that wave.

Skate The tendency of the stylus of a turntable cartridge to seek to slide towards the centre. This is due to the geometry of the tone arm and results in a greater force being applied to the inner side of a groove than the outer side. Tone arms have an anti-skating device fitted to prevent this problem.

Smart Media A small, removable flash memory (i.e. non-volatile) cartridge, used in a host of digital storage situations, notably in digital cameras and digital audio players. It should be noted that many MP3 players reformat Smart Media cards in a way that will not permit them to be compatible with digital cameras.

SNR *Signal to Noise Ratio See Signal to noise ratio.*

Sound Stage A movie set where audio is recorded along with video. But in the home entertainment (audio) context, the sound stage is area between a pair of stereo speakers from which they appear to make the various sounds appear. High quality audio systems will make the sound stage actually *wider* than this space, and provide sensations of both vertical sound placement and depth in the stage, offering a 'holographic' or multi-dimensional audio effect.

S/PDIF *Sony/Philips Digital Interface Format.* A widely used digital audio protocol. It is used as the protocol for all consumer home entertainment equipment. It is distinguished from the professional AES/EBU protocol by incorporating the clock timing information in the main signal. Originally designed for 44.1 and 48 kHz and 16 bits, it now carries up to 96kHz and 24 bits, plus the bitstreams for the various compressed digital audio standards. The connections used are generally coaxial or optical.

Speaker Short for loudspeaker.

Speed of propagation Physical waves, whether sound or electromagnetic, have a typical speed of propagation through various media. This varies depending on the medium. Light travels through a vacuum at 3×10^8 metres per second. Sound travels through room-temperature air (20C) at 343.5 metres per second. The speed varies slightly according to temperature, increasing to 349.3m/s at 30C, falling to 337.6m/s at 10C.

SPL *Sound Pressure Level.* A measure of volume or loudness in decibels. 0dB SPL is the quietest that can be heard. A rock concert may produce up to 120dB SPL. The threshold of pain is a little above this. Hearing damage is a function of loudness and the frequency and period of exposure.

Square wave A signal, the shape of which when displayed is, well, square. In other words, it holds to a negative value for a time equal to half the wave's period, then switches abruptly to a positive value which it holds for the same length of time, then switches back negative again, and so on. How quickly it switches between these states is determined by how far into the higher frequencies the equipment in use can extend. Square waves rarely form part of music, and are primarily used as diagnostic tools, since inspection of how well equipment handles a square wave can reveal a lot about its high frequency handling and whether it shifts phase across its frequency handling range.

Stereo or Stereophonic. In the home, an audio system which delivers two channels of music, left and right, to create the illusion of a plane of sound facing the listener. High quality audio systems will make the sound stage actually *wider* than this space, and provide sensations of both vertical sound placement and depth in the stage, offering a 'holographic' or multi-dimensional audio effect.

Contrast with mono and surround sound.

Streaming (multimedia) is data that is constantly received by, and normally presented to an end-user while it is being delivered by a streaming provider. In a general sense, includes all audio or video playback. The name refers to the delivery method of the medium rather than to the medium itself. The term is

usually applied to media / data that are distributed over the internet, where the delivery systems are either inherently streamed e.g. radio, music, television. The verb 'to stream' is also derived from this term, meaning to deliver media in this manner.

Stylus A small diamond on the end of a cartridge's cantilever. This sits within the groove of an LP and picks up the vibrations recorded therein. The stylus is generally spherical or elliptical in shape, although other variations have been developed, all with a view to more accurately tracking the groove while reducing damage to it. Elliptical styli are only suitable for tracking weights of less than around two grams because their low contact area with the groove can cause damage.

Subjective reviewing Subjective assessment is a vital component in judging any piece of audio equipment. We have not established a set of tests which fully and accurately describe the perceived performance of audio or video components. Particularly with things like loudspeakers, an experienced listener can come to a valuable view of the performance just from a brief listen. That said, subjectivism does not negate the value of objective tests.

Subwoofer A speaker designed to produce only deep bass frequencies. Most subwoofers are 'active' models, which means that they have an amplifier built in. 'Passive' subwoofers require an external amplifier. Active subwoofers also have a level control and, usually, an upper frequency control, although an increasing number are appearing without features not required when connected to a home theatre receiver's Dolby Digital (or whatever) LFE output, which covers a frequency band from 3 to 120 hertz.

Surround Sound An audio system which delivers sound from behind, as well as in front of, the listener. This can be artificially generated by 'virtual surround' systems which process a stereo signal to produce the effect of sounds from the rear, even with just two speakers. More commonly, though, it refers to systems such as Dolby Pro Logic, Dolby Digital and DTS which were designed to deliver specific channels of surround sound from speakers placed slightly behind and to the sides of the listener. These typically also use a centre front channel and, in some newer versions, an additional centre rear channel. In the professional cinema context, surround sound is often called stereo. Contrast with mono and stereo.

S-Video A cable with four pin connectors designed to carry video. Its virtue is that it keeps the luminance part of the signal separate from the chroma part, providing a significantly better picture quality. It is most commonly seen on DVD players and

S-VHS tape recorders, and the TVs for them to plug into. Sometimes the term S-VHS is incorrectly used instead of S-Video.

Sweet spot The seating position or positions at which a stereo or surround sound system produces its best effect, particularly with regard to imaging.

T

Theile and Small parameters Back in the 1960s the Australian engineer Neville Theile and American engineer Richard Small developed a method of modelling loudspeakers, allowing the bass performance of loudspeakers to be explicitly designed, rather than developed through trial and error. Forty years later, their work remains the basis of loudspeaker design. To use their design techniques a number of characteristics of the woofer to be used must be known. These include such things as the driver's resonant frequency, its compliance, its 'equivalent volume' and so forth. These are collectively known as the Theile and Small parameters and are stated by all reputable driver makers.

Three-way loudspeakers A loudspeaker which divides the incoming signal into three different frequency bands for distribution to drivers. It sends high frequencies to the tweeter, the middle frequencies to the midrange driver, and the low frequencies to one or more woofers.

THD *Total Harmonic Distortion* See *total harmonic distortion*.

THX A certification standard controlled and operated by LucasFilm. It covers certification of both cinemas and home entertainment equipment to meet given minimum standards. Originally, on the home entertainment front, there was just one standard: 'THX Certified'. But in recent years this has been replaced by two standards: 'THX Ultra' certification, which is the highest level and is similar to the old standard, and 'THX Select' which is a lesser standard. Note that many brands and products which could easily achieve THX certification decline to seek it for reasons of brand self-respect, or to avoid the cost involved, so THX certification does not necessarily mean that a piece of equipment is superior.

Time alignment Systems for ensuring that audio signals from various loudspeakers or drivers arrive at the listener at the correct time. For example, high end loudspeaker makers will recess the tweeter further into the enclosure to ensure that the high frequencies arrive at the listener at the same time as lower frequencies, with a view to delivering a more coherent sound. With surround sound it is important that the sound from the surround speakers does not arrive early, even though these speakers are often situated closer to the listener than

the main speakers; so home theatre receivers incorporate a system to allow the sound to these speakers to be (adjustably) delayed by some milliseconds.

Title The major divisions for content on a DVD Video disc. Typically the movie is in a single Title, while the trailer is in another Title and so forth. This is the equivalent of a Group on a DVD Audio. A Title is normally subdivided into Chapters.

Tone controls Labelled 'bass' and 'treble', fitted to a preamplifier these provided a means of boosting or cutting the bass or treble of the signal. They typically provide up to ten decibels of boost or cut at 50 hertz for bass and 10,000 hertz for treble. Best avoided for high fidelity.

Tonearm Position the attached cartridge in the correct alignment to play an LP record. Is normally pivoted at the back and provides for an adjustable tracking weight by the use of a spring-loaded or weight-loaded mechanism; and usually have a damped cueing lever to allow the stylus to be gently lowered to the surface of the record. Over the years some makers have provided parallel movement tonearms which do not use a pivot. In theory these should track the LP better, but are difficult to design to work well.

Toroidal transformer See *transformer*.

TOSLink DVD players can be connected to digital audio decoders by means of a digital signal cable. One kind uses wires and sends an electrical signal. TOSLink cables use optical fibre and send an optical (or light) signal. More correctly, TOSLink refers to the kind of plug on the end of such cables. This is roughly square shaped with a small ridge to allow it to click into, and be firmly held by, a socket. Some portable Minidisc recorders and CD players can receive or generate an optical digital signal but these generally require a cable with a different plug, shaped somewhat like a standard 3.5mm stereo headphone plug.

Total harmonic distortion All the harmonic distortion components added together to give a summary measure, though often misleading. The imperfection resides in the fact that, audibly, some of the harmonic components are worse than others. In particular, odd-ordered harmonics from the fifth and up are particularly audible in audio systems, whilst even harmonics (produced by valves) are practically inaudible. Solid state amplifiers typically offer THD ratings of less than 0.1% at rated power output but can still have audible harmonic distortion characteristics (often heard as a sheen or 'metallic' overlay to the sound. Valve amplifiers might offer a 2% THD but sound extraordinarily clean and musical.

Track The divisions within programme material on an LP, CD, SACD or audio DVD. Navigation is most easily achieved by using the forward and reverse 'skip' keys on the remote control.

Transformer A device used to alter the voltage of AC electricity. This typically consists of an iron ring of some kind with two coils of wire wound around it. The input current is fed to one of the coils, which generates a magnetic field in the iron ring and which, in turn, generates a voltage in the other coil. The proportion of input voltage to output voltage is the same as the proportion of the number of coil windings on the input (called the 'primary') and output ('secondary'). Most transformers use either a square-shaped ring with the primary and secondary windings on opposing sides, or are toroidal, which means that the ring is shaped like a donut and the primary and secondary windings cover the entire surface, overlapping each other. Transformers do not work with DC electricity because while DC can generate magnetism in the iron core, a magnetic field cannot in turn induce electricity in a wire unless it is changing (or the wire is moving with respect to it).

Transmission line A system of tuning the bass response of a loudspeaker enclosure that involves a labyrinthine internal structure, with a long internal passage between the rear of the woofer and the outside air. This can enhance bass, although it tends to result in significant phase delays in the deep bass.

Treble The audible frequencies typically constituted by frequencies above about 5,000 hertz, although the dividing line between midrange and treble is one of opinion. The human ear is less sensitive to treble than to midrange frequencies.

TRS *Tip Ring Sleeve*. Another name for a 6.25mm (or 1/4") stereo jack. This terminology tends to be used in professional audio and these plugs tend to be wired for balanced mono operation.

Tuner A component (or module within a component) that can receive an AM or FM radio signal, demodulate it and deliver an analogue audio signal to an amplifier.

Turntable A device to rotate at the correct speed a vinyl LP recording. More generally, the word can refer to the turntable itself along with an installed tonearm and cartridge. The platter on the turntable (the rotating part) is powered by a small electric motor. Different types of turntables are defined by the drive mechanism used to connect motor to platter. The three most common types are idler-wheel, belt drive and direct drive. Belt drive turntables use a rubber-like belt or band running around a pulley on the motor shaft and a rim on the underside of the platter. These appear in a wide range of turntables, from inexpensive ones through to some of the most prestigious models available. In direct drive turntables the motor runs slowly and the spindle at the centre of the platter is

connected to the shaft. These appear in some very high quality turntables and offer particular advantages of high acceleration to speed, plus electronic speed control and stability.

Tweak A subtle change to home audio or A/V intended to improve the sound. This could range from merely adjusting the system's controls, through replacing cables and experimenting with speaker positions, to all kinds of damping and isolating procedures.

Tweeter A small speaker driver designed to produce high frequency (or treble) sounds. This typically operates from 2,000 to 6,000 hertz, depending on the other drivers, up to and sometimes beyond the limits of human hearing at 20,000 hertz. The deeper notes are routed by a crossover network to the midrange driver (if any) and woofer.

Two-way loudspeakers A loudspeaker which divides the incoming signal into two different frequency bands for distribution to drivers. It sends high frequencies to the tweeter and low frequencies to one or more woofers.

U, V

Ultrasonic Audio tones of frequencies higher than capable of being detected by the human ear, generally above 20,000 hertz.

VBR *Variable bit rate* as opposed to CBR or constant bit rate. The flow of digital data increases or slows over time, according to the complexity of the encoded signal. Has the advantage of allocating more of the scarce data space to those moments of video or audio that most need it, while economizing on sections that can get by with less data.

VCD *Video CD*. A movie format popular in Asia in which highly compressed movies can be placed on an optical disc adhering to CD conventions. MPEG-1 compression is used, which is less effective than the MPEG-2 used on DVDs. Because of the data size limitations of CDs, VCD movies are of much lower resolution than DVDs and are usually spread over at least two VCDs.

VCR *Video Cassette Recorder*. The analogue video recording system using tapes in a robust plastic housing. Superseded by the DVD.

VHS *Video Home System*. A consumer-level video recording system developed by JVC in the late 1970s. Despite urban legends to the contrary, it was not noticeably inferior to Sony's Beta system (although the latter offered a slightly

higher horizontal resolution of around 300 lines, compared to VHS' 250 lines), which had beaten it to market. Eventually VHS prevailed through having longer record-playback times. There was also an electrically similar, but physically smaller, compact version of VHS called VHS-C for use in digital video cameras. Superseded by DVD-R.

Voice coil The coil of wire that is attached to the back of the cone or dome of a loudspeaker driver. This is surrounded by a strong, close magnet so that when electricity is fed into the coil, it moves to and fro, moving the attached cone or dome to and fro, generating sound.

Volt The standard unit for electrical potential.

W, X, Y, Z

Watt A unit of power. For DC, it is equal to the current multiplied by the voltage (one watt equals one volt times one amp).

Wavelength The end-to-end physical measurement of a cycle in a repetitive signal, measured in metres (or convenient multiples). Audio wavelengths are generally in the range of 17mm to 17 metres (at air temperature 20C). The human eye responds to light in the wavelength range of 380 to 780 nanometres. The wavelength of a signal can be calculated by dividing the speed with which the signal propagates through a medium by its frequency.

White noise Random audio noise where the average amount of power is the same across all audio frequencies. Sometimes used as a test signal, but it is weak because real audio has power characteristics more like pink noise.

Woofers The largest driver in a loudspeaker enclosure, sometimes called the bass driver. This provides the bass sounds while the higher sounds get routed by the crossover network to the midrange driver (if any) and tweeter. Many modern loudspeaker designs use two or more smallish woofers rather than one large one, which is more consumer friendly (smaller enclosures), but less able to offer high impact dynamics.

Wow A defect affecting analogue audio signal sources that rely on rotating the medium, particularly LPs and compact cassettes. Wow is a slow, repetitive speed variation, typically repeating at less than once per second. If an LP or audio cassette undergoes this, it produces slow variations in the playback frequency. Wow is specified in per cent and specifications of more than around 0.1% are

unacceptable. Digital sources such as CDs are immune to wow because they lock their playback speed to a solid-state timing device.

XLR A professional audio connection standard in which the signal pins are not connected to the shielding earth. This allows them to carry balanced audio signals. Most commonly seen in three pin versions (for mono) although there are also five pin (stereo) versions.

Zero cross distortion See *cross-over distortion*.