

LB1 Loudspeaker wins HI-Fi Grand Prix Award



Audio Video International Magazine has awarded PMC their Hi-Fi Grand Prix Award. In the Product of the Year category the award went to the: LB-1 Loudspeaker.

The Hi-Fi Grand Prix competition winners are determined by the votes of 38,000 audio retailers throughout the United States, with confirming review by a Grand Prix committee of leading audio critics and writers.

The criteria for selecting the best products are based on



This Issue

Frequently Asked Questions **P.1**

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Frequently Asked Questions

Q: What is Damping Factor?

A: Damping Factor is a measure of the amplifier's ability to control the woofer, and is measured by dividing the speaker impedance, (normally 8 ohms), into the amplifier's output impedance, (usually in the range of 0.02 ohms). The lower the amplifier's output impedance, the less the amplifier's output level is affected by variations in the speaker impedance. Also, since the woofer's voice-coil can act as a generator, within its magnet structure, the amplifier needs a low output impedance to act as a method of damping the woofer's tendency to keep moving after the signal has stopped. In the example above, the damping factor would be $8/0.02 = 400$.

Briston amplifiers have output impedance slightly below 0.01 ohms, and therefore have a calculated damping factor of over 800, (though we conservatively rate them at 500). This parameter is affected by the speaker cable resistance. Even heavy 12-gauge wire has a resistance of about 0.0016 ohms per foot. (Remember we need to double that for twin-lead speaker cable). Thus, it would require only 6.25 feet of 12 gauge per speaker to have a total resistance of 0.02 ohms, ($0.0016 \times 2 \times 6.25 = 0.02$), cutting a damping factor of 400 in half, to 200. Briston recommends keeping speaker lead length to a minimum for this reason.

Keep in mind that damping factor is also affected by other real-world impedances, including the speaker-cable resistance, and the varying resistance of the speaker's own voice-coil. The voice-coil of a typical 8-ohm loudspeaker has a DC resistance of between 4 and 6 ohms. This resistance increases with temperature by 0.4%/Deg. C. It would thus require only a 25-degree rise in voice-coil temperature to increase its impedance by 10%. If it started with a DC resistance of 4 ohms, the extra 10%, (0.4 ohms), would reduce the actual damping factor to twenty, ($8/0.4=20$)!

It is worth noting that it would probably take only about 5-10 Watts to raise the voice-coil temperature by that amount. Add in the likely speaker-cable resistance of about 0.1 ohms, (10

feet of 16 gauge. cable), and it is obvious that the amplifier's contribution to the overall, real-world damping factor of the system is close to nil.

Whether the amp measures 300 or 3,000,000 under ideal conditions, the actual damping factor of the system will almost never exceed 100 anyway.

Getting Wired

Q: What really determines a cable's behaviour?

A: A cable's physical properties such as conductor diameter and conductor spacing combined with its electrical properties such as conductor resistivity and insulation dielectric constant determine what is known as the "primary constants". These are the series resistance, R, of the conductors, the series inductance, L, of the conductors, the shunt capacitance, C, between the conductors, and the shunt conductance, G, (reciprocal of shunt resistance) between the conductors. Each of the four primary constants is distributed uniformly along the length of the cable and dictates its electrical behaviour.

Does this mean that special weaves, or critical dimensions, or the mix of size and position of strands, or specific properties of certain conductors are not important? No, but you don't need to get caught up in the details of the manufacturing processes and imaginative marketing explanations. The simple truth is that a cable's performance is reflected in the magnitudes of its primary constants. How do we know this? The cable's primary constants and the frequency of interest are the only variables in the formulae for cable attenuation, frequency response, velocity of propagation and characteristic impedance. Don't misunderstand; the proper choice of materials and skilled craftsmanship can have a significant impact on a cable's performance. My point is that if they do, it will always show up in superior L, R, C and G numbers.

Q: So how can you choose the right cable?

A: Understand which cable characteristics are relevant to

product quality and sales performance, not merchandising or advertising programs. They are:

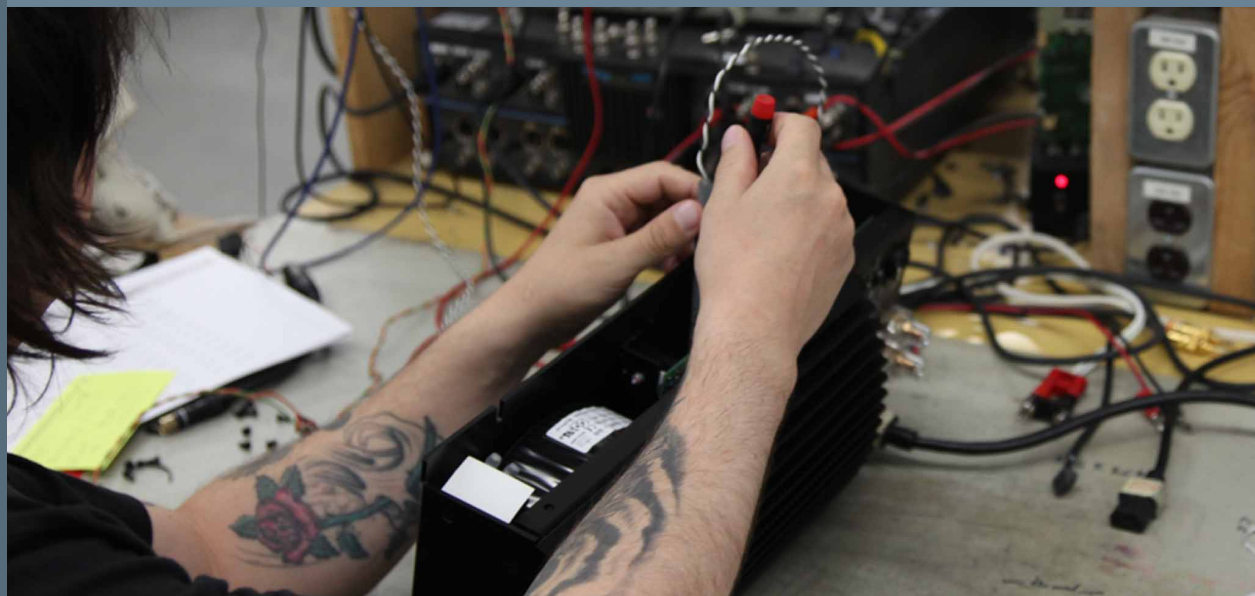
Fidelity of signal reproduction.

Design engineering.

Reliability.

Craftsmanship & product integrity.

Value for price relationship.



your specific application. There is no such thing as a perfect cable and therefore all cable designs represent a compromise to achieve optimum performance for a particular application. For example, superior interconnect cables will have relatively little shunt capacitance, C . The actual amounts of series resistance, R , and series inductance, L , are not as important in this interconnect application because their impedance magnitudes are insignificant compared to the circuit load impedance, Z_L , that usually runs about 10 k ohms or higher. Interconnect cables generally carry low-level signals and are more susceptible to signal corruption by electromagnetic interference (EMI) when employed in electrically noisy environments. In such an application, the percent braid coverage will be an important consideration to ensure adequate shielding is achieved. Is the interconnect going to be frequently connected and disconnected as in a patch panel application? If so, the cable should be physically robust and equipped with high quality connectors that offer consistently good electrical connection, durability, reliability and freedom from noise bursts.

A speaker cable, on the other hand, should have very low series resistance, R , and series inductance, L , while shunt capacitance, C , is relatively unimportant in this low impedance, high current application. Shielding is almost a non-issue in speaker cables as signal levels are very large and circuit impedances very low. Speaker cables, however, should be kept as short as possible to minimize power losses and the associated dynamic compression of the music signal. If a choice must be made as to which of your cables should be made longer, always let the additional length be taken up with your interconnects. We haven't forgotten about the shunt conductance, G , of the cable. This primary constant represents the conduction or leakage current between a cable's conductors through a less than perfect dielectric material. As such, shunt conductance, G , is a bad thing as it contributes to signal loss. Fortunately, in any cable worth its salt, it is extremely small and can be ignored in most cases.

Q: Is a cable's characteristic impedance important in your application?

A: There is a lot of foo-foo dust floating around about this topic so let's discuss some common sense ways to help you

tiptoe through the minefields. First, there is a very practical reason why you don't want to match the source impedance, Z_S , to the cable's characteristic impedance, Z_O , and the load impedance, Z_L , unless it is absolutely necessary. It is terribly inefficient. For example, let's examine the power amplifier and loudspeaker interface. The output impedance which is the source impedance, Z_S , in this case, of a well-designed power amplifier will be practically 0 ohms. This virtually perfect voltage source will then be able to deliver maximum power to the loudspeaker regardless of its load impedance, Z_L . Technically, this circuit arrangement is called a bridged voltage source. It offers the advantages of lower distortion, efficient signal transfer, lower noise pickup and longer cable drive capability, provided that the source impedance, Z_S , is at least ten times and preferably more than fifty times smaller than the load impedance, Z_L . Assume for the moment that we were able to obtain a loudspeaker that offered an ideal load impedance, Z_L , of 8 ohms at all audible frequencies. Would it make sense to design an amplifier with an output impedance, Z_S , of 8 ohms? Absolutely not as half the output power would be dissipated in the amplifier itself!

The only time you need to consider matching the Z_O of a cable to a source and/or a load is when the physical length of the cable becomes a significant fraction (greater than 1/30) of the electrical wavelength of the signals travelling on it. Only then will signal reflections and variations in the cable's velocity of propagation with frequency cause audible distortions. The worst case scenario exists at the highest audio frequency being reproduced. For a 20 kHz audio signal travelling along a typical interconnect cable, this places the maximum length very conservatively at about 200 metres before transmission line behaviour might be considered necessary. I'll bet that's a tad longer than your interconnects. For any audio cable shorter than this, the series resistance, R , series inductance, L , shunt capacitance, C , and shunt conductance, G , of the cable behave like lumped circuit elements so matching the characteristic impedance, Z_O , is irrelevant.

The characteristic impedance, Z_O , of all cables vary significantly with frequency through the audio range of frequencies. The ubiquitous RG59 coaxial cable that we all know and love and refer to as a 75 ohm cable has in fact a characteristic



impedance, ZO, of about 4 k ohms at 30Hz and only approaches its 75 ohm value at frequencies higher than 100kHz! Only phone companies are likely to have cables long enough to make the use of delay equalizers mandatory to compensate for such problems.

Q: What about FM cables?

A: Are the wavelengths of FM signals similar to the dimensions of your cable from your antenna or cable company connection? The 88MHz to 108 MHz FM broadcast band signals will have wavelengths on a typical coaxial cable ranging from about 2 metres to 1.6 metres respectively. Since the physical cable lengths for this application are at least as long as this, transmission line treatment is clearly in order. To eliminate reflections, you should make sure that both the source and load are properly matched to your 75 ohm cable. If your antenna and/or tuner only has a balanced 300 ohm termination, it is essential that a 300 ohm to 75 ohm matching transformer (balun) is employed to prevent impedance mismatches.

Q: What about Digital Audio Cables?

A: Are the wavelengths of digital audio streams similar to the dimensions of your digital interconnecting cable? Even though the sampling rate of a CD player is only 44.1 kHz, the serial data stream made available to users on many players has a relatively high 3.072 MHz repetition rate. Many audiophiles prefer to steer this data to outboard DACs and other digital processors. Since the data consists of a string of square waves, it is important that the leading and trailing edges make clean transitions between the "0" and "1" levels.

This requires that sufficient numbers of related harmonics associated with the fundamental are transmitted distortion free to minimize jitter. To achieve this, it is desirable to transmit without distortion frequency components as high as 50 times the fundamental frequency. This places the range of wavelengths of the data stream between about 58 metres and 1.2 metres. Once again, this is not a time to get sloppy with your choice of cables or impedance matching. Check the source and load impedances of your digital equipment and make sure your select cables with the appropriate characteristic impedance, ZO. A digital AES/EBU interface, for example, should be connected to a digital cable with a characteristic impedance, ZO, of 110 ohms.

My thanks to Jim Hayward for the above cable article. Jim is a contributing editor for Andrew Marshall's, Audio Ideas Guide.

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