

# ARCAM

## Balanced audio

### Principle Advantages of balanced Audio Connections

Balanced audio connections, usually using an XLR type connector can be found on numerous pieces of audio equipment. Both in the professional and consumer markets, these connections have been used in a variety of applications, mainly for good reason.

The main objective of a balanced connection is to reduce noise pickup. By using two signal connections twisted together and an earth or shield in the same cable the signal can be sent to the receiving device as both a positive going and negative going signal. Using this method the receiving device considers the input signal to be the difference between the two signals, for example if one signal is +1V and the other -1v then the input signal is considered to be +2V.

In a perfect world, the signals received are identical but a mirror image of each other. Thus the difference between can accurately represent the shape of an original signal. Sadly the world is not a perfect place!

In practice, using any analogue audio interface, electrical noise pickup is, to a degree, inevitable. However, with a perfect balanced connection this additional noise can be eliminated.

Simply put, any noise pick up is likely to be absorbed by both signal leads in a balanced cable in the same way, and most importantly, in phase with each other. This type of noise is called "common mode noise" since it is induced equally in both signal conductors. For example, if the noise that is induced causes a small rise in the voltage in one conductor it would cause a similar rise in the other conductor. For example, if the positive cable is at +1v then the negative cable will be -1v and the difference in signal level is 2v. If a noise of +0.1v is then induced in both cables the difference between them will still be 2v (+1.1v and -0.9v).

Remembering that the signal at the receiving end is judged by the difference in the two conductors, little or no change will be seen at the receiving end since the difference has not changed.

### So what does this mean in practice for a domestic Hi-fi system?

Firstly, it should be pointed out that adding balanced connections, no matter how they are engineered, has a significant cost penalty. XLR connections and balanced output and input stages are significantly more expensive in parts cost than regular RCA / Phono type unbalanced connections. Therefore, if balanced audio connections are to be implemented we must be sure that they represent a useful improvement in overall sound quality or risk a poor value for money judgement.

## **Signal Level Considerations**

The "noise cancelling" effect is very useful with small signals where any noise pickup will be of a proportionately higher value compared with the signal itself. To this end the most common use of balanced audio connections in the professional field is with microphones when maximum signal levels are typically as low as a mV or two (a mV or millivolt is one thousandth of a volt).

In a domestic hi-fi system microphones are not used and therefore we need to find out where small signals, susceptible to noise pickup are used. Speaker cables carry signals in the "several or tens of volts" range where noise pickup is irrelevantly small. So, it is the "line level" connection between source component and pre amp and from pre amp to power amp where balanced audio is most often found.

Firstly, let us be clear about what a "line level" signal actually is. The textbook definition, as far as it is, is "a signal of 775mV into a 600ohm load". In practice, however, modern CD players for example have an output of 2V or more. Bearing in mind that this represents fairly large signal in terms of any potential noise pickup, the arguments for using balanced audio connections here is highly debatable at best.

Between pre-amp and power amp the signal is actually markedly smaller than that between pre-amp and source since the volume control in the pre-amp can be consider an attenuator (unless it is set to maximum volume of course)! Therefore, in signal level terms the most useful place to use balanced connections is between pre-amp and source. Also, power amp gain is fixed and therefore any noise induced between the pre amp and power amp is more likely to be audible at normal listening levels.

Curiously, the most obvious application for balanced audio in a hi-fi system, between turntable and phono stage with signals of only a couple of hundred micro volts, is rarely if ever used.

## **Cable Length Issues**

Since the potential for noise pickup increases with the length of the cable in which it must travel it is worth also considering where the longest signal cables are in the system.

For systems with source, pre-amp and power amps close together (on the same rack for instance) cables lengths are typically short (1 meter / 3 feet or so) and thus the potential for serious noise pickup is quite small. In this type of installation the speaker cables are typically longer but as discussed earlier, because of size of the signal this in not relevant.

In higher end systems, it is fairly common to have mono power amplifiers close to the speakers to avoid long speaker cable runs (the high current nature of speaker outputs leading to high losses when long speaker cables are used). In this case balanced audio connections between the pre-amp and power amps can be useful as cable runs are often quite long and noise pickup is more likely.

Finally, balanced connections can also help eliminate ground loops, which cause hum. This is caused where different components are at differing ground potentials. Again this is

more common between pre amp and power amplifiers where one or more of the power amplifiers may be remote from the pre amp and on different mains circuits.

## Conclusions

Whilst balanced connections can make useful improvements to noise rejection in HiFi systems they also introduce considerable cost. It is therefore important to examine their application to make sure they will have tangible benefit considering the cost penalty involved.

It is Arcam's opinion that the best use can be made of balanced connections in high-end two channel systems is between pre amp and power amp as this is where signal levels are small and cables lengths can be long. In these circumstances the extra cost involved of a balanced connection are justified by the improvement in sound quality.