Unbalanced to balanced wiring

How to build your own cable to feed XLR balanced inputs from unbalanced outputs

1 Preface

When dealing with unbalanced sound sources, for example DJ consoles or semi-professional equipment, one could face the issue of connecting an unbalanced RCA output to an XLR input, like the ones found in Powersoft amplifiers.

2 Balanced vs. unbalanced

1.1 Analog signals

Balanced lines, due to their differential nature, are less prone to pick up noise and interferences than unbalanced lines. Thus if using the latter type of connection one must be conscious about the wire length and the environment where the cable is laid.

As a rule of thumb please keep this type of wiring within the maximum length of 3 meters.

If longer distances have to be covered or grounding problems ore found, a transformer isolation device is mandatory (either an ISO box or a DI). This piece of gear creates a differential balanced line from an unbalanced source with the aid of an internal transformer. Passive and active DI's are found on the market, please keep in mind that active ones should have an external DC input, phantom powered only, are not suitable for our purpose since the amplifier cannot provide DC power from its inputs.

Unbalanced devices usually have a nominal output voltage of -10 dBV (316 mV RMS), while balanced professional ones are expecting a +4 dBu (1.23 V RMS) signal. Passive balancing devices are not capable of gaining the 12 dB of difference to compensate this. If experiencing weak signal at the input stage consider using an active one.

When laying cables (especially unbalanced), care should be taken in avoiding close placement of audio and power lines, since this could introduce noise in the sound system. Usually AC power will induce low frequency hum, while dimmered power (eg. for lights) will induce a variable louder noise.

A clever way of arranging cables is to cross audio and power at right angles, that way induction will be greatly reduced since the electromagnetic fields will not concatenate.

1.2 Digital signals

Feeding an XLR AES3 input from an unbalanced S/PDIF out is a common practice but it's not always a fail safe operation; the two protocols are differing for a channel status bit, that specifies the function of the first 6 bits of the control word.

AES3:

- Tension: 2 to 7 V_{pp} (min input 0.2 V)
- Current: 64 mA
- Impedence: 110 Ω

S/PDIF:

- Tension: 0.5 V_{pp} (min input 0.2 V)
- Current: 8 mA
- Impedence: 75 Ω

A S/PDIF to AES3 conversion can be performed with success in many cases, employing a simple custom wire. As mentioned above, anyway, there could be troublesome cases requiring a converter device.

Building an AES3 to S/PDIF cable without any attenuation, on the other hand, is not a recommended practice since the receiving device could be damaged by the higher AES3 signal.

3 Connecting unbalanced and balanced devices

1.3 Analog devices

If using an isolation transformer device is not possible and devices are properly grounded (beware "Pin 1 problem"), follow FIGURE 1 and FIGURE 2 diagrams to build a custom cable.

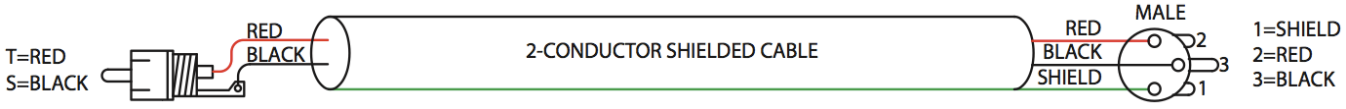

FIGURE 1: RCA to XLR connection

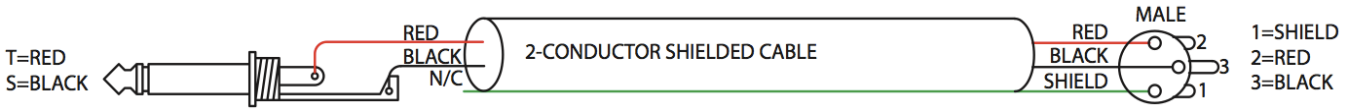

FIGURE 2: 1/4" TS Jack to XLR connection

1.4 Digital devices

Given the impedance mismatch between S/PDIF and AES3 protocols, by using a simple adapter cable as the one showed in FIGURE 1 is not suggested (although it may works in some cases, expecially with short distances).

A passive impedance adapter as showed in FIGURE 3 should be employed instead.

FIGURE 3: Neutrik NADITBNC-M passive impedance adapter

If some devices are still encountering problems this may be due the protocol differences as specified in chapter "1.2 Digital signals"; an active digital device should be used to solve this issue, an example is showed in FIGURE 4.

FIGURE 4: Hosa Technology CDL-313 active protocol translator

4 References

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- http://www.rane.com/pdf/ranenotes/Sound_System_Interconnection.pdf
- http://www.rane.com/pdf/ranenotes/Interfacing_AES3_&_SPDIF.pdf
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- http://pin1problem.com

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