# ANALOG AUDIO INTERLINKS: DOES QUALITY MATTER?

## Introduction

Audio interconnects can be bought for prices ranging from a few Euro's to hundreds if not thousands of Euro's. For some people, this is loose change, for others, this is hard-earned cash. Does spending this hard-earned cash on an expensive cable upgrade improve the quality of ones beloved audio gear, or does it merely finance the gold plating of some executive's Humvee?

The Internet is filled with pages talking about the sense and nonsense of high quality audio interlinks. But quoting theory and numbers isn't going to decide this issue. Therefore, I set out to put some to the test. Not by double blind testing that will be disputed (or ignored) forever, but by using measurement techniques that will yield clear and audible results.

---

## Measuring methodology and equipment

There are a couple of pieces of equipment used for testing:

- Digital PC scope: Velleman PCS100.
- Function generator: Gwinstek GFG 8015G.
- Meter used to measure cable resistance: Velleman DVM890 digital multimeter.
- Meter used to measure cable capacitance and inductance: Velleman DVM6243 digital LC meter.
- Source for recording: Samsung YP-U2 mobile music player.

- Recording device: Creative Soundblaster Live!

However, I designed and built the most important piece of equipment myself: a difference amplifier. The numbers collected by the scope and function generator are helpful, but in the end, it's the recordings that will tell the story.

I used the following royalty-free music fragment to make the recordings (original was in FLAC format):

- Music fragment used for recording.

This is one channel of the difference amplifier:

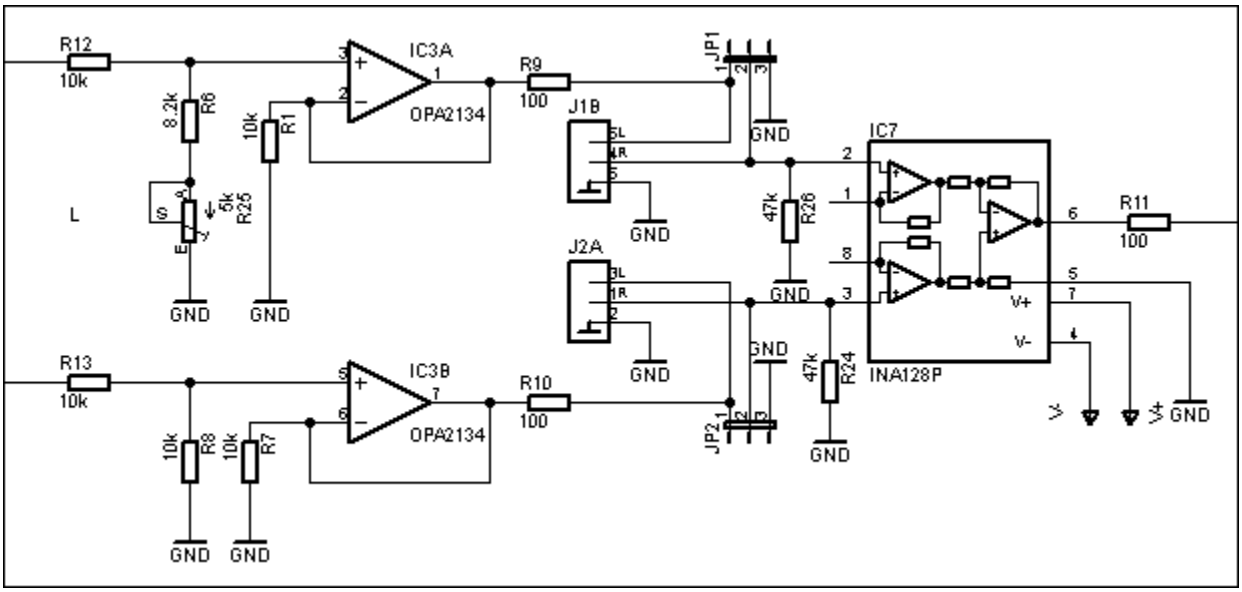


Figure 1. One channel of the difference amplifier.

And this is what it looks like built:

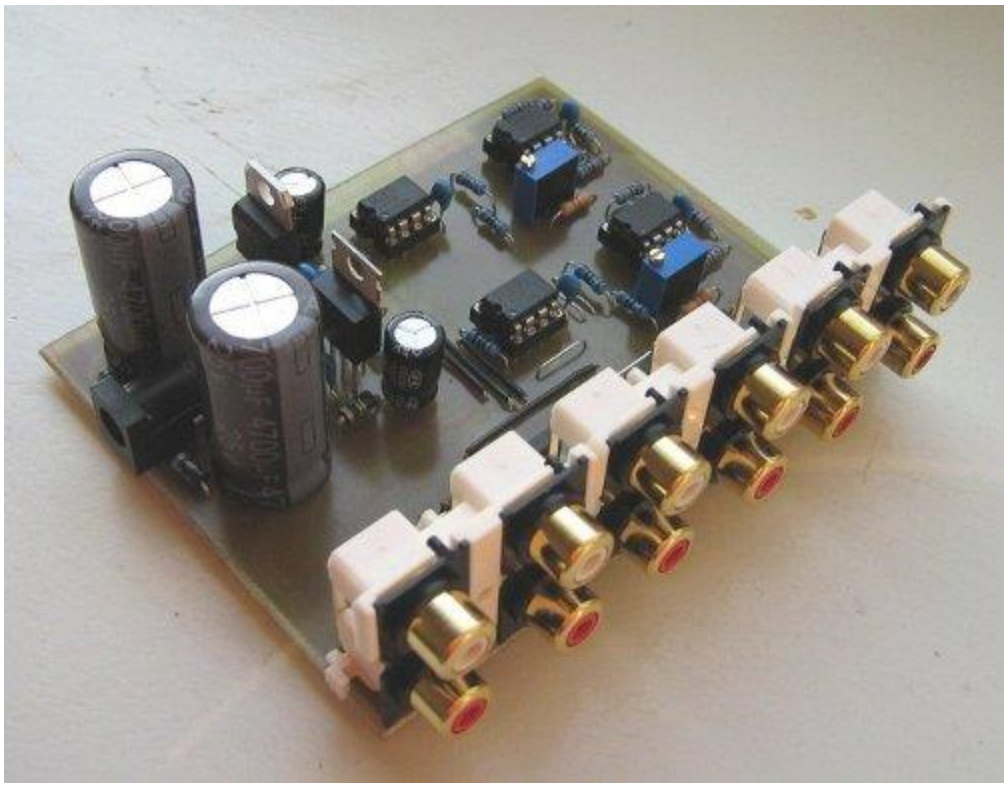

Figure 2. Constructed version of the difference amplifier.

The incoming signal is fed to two OPA2134 opamp buffers, which in turn drive an interlink cable each. The signal that comes back in, is fed to an INA128 instrument amplifier, which is designed to only amplify the difference between the two inputs (in this case, it 'amplifies' by a factor of 1 (which will change in future versions, because rejection is better with higher gain). The resistors before the input buffers form a divider network, where one of the buffers has a variable one. This allows me to do careful calibration for maximum rejection.

First we need to set a baseline; we need to know the error the device itself has. To this end, besides being able to route the signal back through interlink cables, I also included bypass jumpers (jp1 and jp2 in the schematic).

I measured the input signal after the voltage divder at the non-inverting input of the opamp and the output signal at the output of the 100 Ohm output resistor of the INA128. I determined the following rejection ratio's:

| Frequency (Hz) | Input voltage (V) | Output voltage (V) | Rejection (dB) |
|---|---|---|---|
| 1000 | 3.42 | 0.0008 | 72.6 dB |
| 5000 | 3.44 | 0.0029 | 61.5 dB |
| 10000 | 3.46 | 0.0060 | 55.2 dB |
| 15000 | 3.46 | 0.0091 | 51.6 dB |
| 20000 | 3.47 | 0.0121 | 49.2 dB |

Table 1. Rejection measurements when internally jumpered.

These numbers don't mean anything to most people, so here is a recording of it, starting with the full signal and the bypass jumpers added while it's playing:

- Recording when internally jumpered

As you can hear, there is virtually no signal left.

---

## The contenders

The first two cables are two indentical short cables. One of them I use as reference to compare everything with.

Two cheap cables, one used as reference.

The next cable is my very special 'El Sabotage'. It's a regular OFC cable with gold-plated plugs, but with 10 Ohms of resistance soldered into one end and 220 pF of capacitance in the other. I have already been able to fool people, including cable salesman, with this cable; they could not pick it out in a blind test.

Sabotaged cable.

This is an extension cable I also included in the tests. Long cables are considered evil, so let's find out what impact they have.

Extension cable.

The next cable is quite shocking. I went to an HiFi audio store under the guise of wanting to do a cable upgrade. I asked if I could bring home some test cables for me to decide whether to actually do an upgrade. They didn't want to give my any of the known brands (Siltech, Van den Hul, etc), but they gave me their in-house brand of high quality cable. Well, seriously, I would be ashamed to try to sell this to anyone; cheap looking plastic plugs (actually very expensive "Bullet plugs"), no cable tension relief, a connection that doesn't 'hug' the cinch bus and it has unshielded wiring. And during testing, it felt so flimsy, I was afraid of breaking it all the time.

I really wonder what the rationale is for not using a shielded cable. I mean, this is basically an antenna. Surprisingly though, I was not able to introduce noise or hum by touching the outside of the cable. Normally with unshielded cable, you can easily inject hum, even by touching the insulation. But I guess because it was

connected to a low impedance source, all injected noise was shorted. However, I suspect this cable can produce a lot of hum with certain source devices when they're turned off.

In-house brand of high quality cable (referred to as HQ1 in tests).

Next I measured the electrical properties of the cables:

| Cable | Resistance | Capacitance | Inductance |
|---|---|---|---|
| Reference cable | 0.2 Ohm | 70 pF | 4 µH |
| El Cheapo (same as reference) | 0.3 Ohm | 73 pF | 4 µH |
| El Sabotage | 10.9 Ohm | 358 pF | 190 µH |
| Extension cord | 1.2 Ohm | 540 pF | 30 µH |
| HQ 1 | 0.3 Ohm | 8 pF | 4 µH |

Table 2. Electrical properties of the cables.

These values are not unexptected, unless the inductance values. But I tested my meter and I noticed that resitance completely throws of the inductance measurement, so especially for the cables with some resitance, the inductance values are not really trustworthy.

Source : http://www.halfgaar.net/interlink-comparison