Technical Description: The TARA Labs Zero Interconnect

After more than fifteen years of development and experimentation, the Zero Interconnect cable makes the vacuum dielectric cable design a reality. During the course of the development of the Zero Interconnect, many designs and products such as the Air Series from TARA Labs provided the necessary first steps along the path to the production of the ultimate interconnect cable.

In order to properly discuss the development of the Zero Interconnect cable, it is important to understand the absolute importance of the conductor(s) within any cable. Of all of the component parts that make up any cable, the cable will not function without its signal carrying conductors. It is for this reason that the conductors are the first and most important component of any cable design.

For over 20 years, Matthew Bond at TARA Labs has studied literally hundreds of different audio conductors in isolation, to understand the specific function of conductor metal type, conductor size, and shape, as well as metallurgical treatments such as annealing. In this white paper we will not be able to answer nor discuss all of the relevant factors that determine cable performance, but we will be able to discuss the importance of the audio conductor and why the Zero Interconnect cable is a landmark design in audio cable history.

For 15 years TARA Labs has been using a proven testing methodology called CCZT* to research and to demonstrate the differences between conductors of varying size and shape. This testing methodology has been available for peer review, published in audio magazines, available on the TARA Labs website and has been used at the Swarthmore College of Engineering. The CCZT test is able to demonstrate the rising impedance with frequency of an audio conductor. We can see that a larger diameter conductor will have rising impedance versus frequency, or in other words, that a larger diameter conductor will roll off higher frequencies more so than a smaller diameter conductor.

In terms of the component parts within any cable, we can say that if the conductor size and shape are optimized for linearity with frequency, then the conductor spacing and geometry, and the materials used to insulate and isolate the conductors within the cable, will be the remaining factors that will create differences in the sound. Obviously, when the conductors are the most revealing that they can be, then it is easier to hear the influence on the sound or the differences that the dielectric materials and the geometry or spacing can produce in the sound of a cable.

The geometry or spacing can be optimized to further create the most ideal cable interface. This “ideal” interface may be determined by setting a standard for the electrical characteristics to be achieved; in the case of an interconnect cable we would typically prefer to have lower capacitance figures, to achieve higher bandwidth and a more linear frequency response. This is achieved by increasing the spacing between the conductors. However, if the spacing between the conductors is made wide enough to increase the bandwidth of the interconnect cable, then the RF/EMI energy in the shield is more easily coupled to the conductors. Since shielding is required, it should be displaced from the conductors at a distance sufficient to mitigate the coupling of the RF and EMI energy from the shield in to the signal carrying conductors.

The ideal interconnect would comprise a pair of signal carrying conductors suspended in air, or more ideally, in a vacuum. The use of a vacuum has long been acknowledged as the theoretically ideal dielectric environment. The obvious problem is how to maintain the conductors in position, in their relative geometry or spacing with one another.

To suspend the conductors apart in their relative geometry or spacing with one another, Matthew Bond at TARA Labs designed a unique and proprietary air-tube™. The air-tube itself is extruded from the highest quality plastic material, Polytetrafluoroethylene (PTFE is commonly referred to as Teflon®). The air-tube design is unique in that it has internal galleries or arteries that run along the inside walls of the tube. These galleries can hold conductors that may be insulated with different plastic insulation materials or none at all. Therefore, the air-tube design is a minimalist approach, where only the essential parts are used to construct the cable. In this way, we are not using anything but the essential elements to make the interconnect cable and we are able to eliminate the insulation material around the signal carrying conductors.

Materials that are used to insulate and isolate conductors from one another are called dielectrics. In recent years, higher quality plastic materials such as Polytetrafluoroethylene (PTFE) have been developed to make dielectric materials less reactive in order to reduce dielectric distortion. However, all dielectric materials are reactive to some degree and the effect is likely a frequency dependent phenomenon. That is, different materials absorb and release different levels of signal energy at different frequencies, and this I believe, is why different dielectric materials have a sonic character of their own. However, when we compare raw conductors to insulated conductors, it is possible to hear the sonic contribution that the different dielectric or insulation materials make to the sound of a conductor. The conductor that is the most neutral and revealing, has no insulation material and has a smooth polished surface.

The conductor that is used in the Zero Interconnect is the Rectangular Solid Core® conductor, exclusive to TARA Labs. The RSC® conductor begins as 99.999999% (8 Nines) pure copper, which is then super-soft annealed, and polished in line after annealing. TARA Labs has determined that this conductor, measuring 0.0024” by 0.0011” has advantages not offered by other conductor designs.

To complete the Zero interconnect cable it was necessary to develop an RCA plug and an XLR plug that would be an absolutely unique design, and the world’s first ever to hold a vacuum. The sophisticated design draws upon technologies from other industries, such as mass flow control and aerospace engineering, and requires manufacturing of Mil Spec precision.

Moving forward from the rear of the plug, the plug itself comprises a clamping mechanism to fix itself to the air-tube and an internal chamber, which is sealed with O-rings. Through a specially designed valve in the plug, a vacuum is drawn within the chambers of the air-tube so that the conductors themselves are within a vacuum environment.

The completed Zero Interconnect represents an all-out attempt to create the ultimate interconnect cable; the theoretical ideal of having a pair of conductors suspended in a vacuum, whilst knowing the practical issues involved in building a cable for the real world. With an absence of materials within the construction of the cable, the Zero Interconnect and its vacuum dielectric environment delivers an extremely low background noise and an ability to reveal very subtle information. The result is an interconnect cable with extremely low capacitance (3.5pF/ft) and an ability to accurately reveal the natural harmonic structure of music with great detail.

* Please refer the “The Science of Cable Design” publication from TARA Labs, Inc. by Matthew Bond for further explanation on CCZT.