Technical White Paper

The Atlas Asimi Interconnect Cable

The Ideal Cable

In introducing the Asimi interconnect cable Atlas has tried to produce the closest approach to a theoretically perfect cable. In doing so it has gone back to the first principles of cable behaviour.

In most respects the ideal cable would be two un-insulated conductors floating in free air. They would be widely spaced and form straight lines to ensure that the capacitive and inductive components would be zero. The cable would then be no more than a simple resistor with no complex impedance components or frequency response variations.

The conductors should have a high degree of homogeneity to ensure that the speed of signal transmission is the same along the outside surface as along the outer core. This is because the high frequencies travel along the outer surface; the so-called “skin effect”. In this respect such hybrid conductors as silver-plated copper wire often offer a poor performance.

The Conductors

The Atlas Asimi cable uses only the finest available conductors, specifically ultra-high purity silver wires which have been made by the "Ohno Continuous Casting" or OCC process. In this process the mould is heated to a temperature which is much higher than the melting point of the silver in order to prevent nucleation at the mould wall and to ensure axial directional solidification. The strands produced in this process are always single crystals with a very smooth surface and the granular structure is aligned in the longitudinal length of the wire rather than being aligned across the wire. Indeed there is less than one grain in about 700 feet of conductor so the audio signal travels through a continuous conductor instead of traversing repeated grain boundaries.

The Insulation

In order to avoid surface damage from corrosion as well as accidental short-circuits the conductors are coated with a layer of insulation; usually a plastic material. But such insulation has a property of charge storage, commonly described as its dielectric constant figure. The cable forms a small capacitor with the two conductors being the plates of the capacitor and the insulation being the storage dielectric. So the presence of the insulation dielectric causes the cable to behave as a complex impedance rather than as a simple resistor; it reduces the transmission speed of the cable and can cause the cable to have an irregular frequency response when it is used with other equipment.

The dielectric constant or more correctly, the relative static permittivity, of a material can be measured relative to the behaviour of a vacuum. By definition a vacuum has a dielectric constant of 1.0 whilst air has a figure of 1.00054. The common Polystyrene family of plastic insulators has figures ranging from 2.7 to 3.3 whilst the paper insulation popular with some Japanese manufacturers of “exotic” cables, has a dielectric constant of 3.5 or more. The highest performance insulator in common use is polytetrafluoroethylene (PTFE) often known by the brand name “Teflon”. This material has a dielectric constant of 2.3 or more.

In an attempt to reduce the dielectric constant of the insulation for such cables as low-loss co-axials for satellite receivers etc. a foamed polystyrene was developed where a significant proportion of the material is air in the form of micro-bubbles. By contrast Polytetrafluoroethylene is not a conventional thermoplastic; is not so easily processed and could not be “foamed” in the same way. However recently a new Microporous PTFE foam has been developed which has a dielectric constant of 1.2 or less. In fact a material whose performance is getting very close to that of free air as a result of the extremely porous PTFE foam being mostly composed of air.

Cables using Microporous PTFE foam as an insulator currently represent the "state of the art" in cable design; in fact cables which are very close to the "no insulator" ideal.

Without arguing whether the effects of the cable dielectric are audible they are certainly measurable and therefore are almost certain to be audible.

The Speed of Electricity

The Atlas Asimi cable probably transmits a signal along its conductors faster than any other cable used in the audio world. What does this mean? Well the Speed of Electricity is the wrong definition to use because it actually refers to the relatively slow movement of free electrons through a conductor in the presence of an electric field, and it is often confused with the propagation speed of an electromagnetic wave; the waveform that actually carries information.
Free electrons in any conductor vibrate randomly, but when a DC voltage is applied the electron’s motion will increase in speed proportional to the strength of the electrical field. However when an AC voltage (such as a recorded music signal) is applied there is no net movement at all; the electrons simply oscillate back and forth in response to the alternating electrical field.

Electromagnetic wave propagation is much faster, and depends on the dielectric constant of the material. In a vacuum the wave travels at the speed of light and travels virtually as fast in free air. Propagation speed is determined by the dielectric constant of the insulation, so that in an unshielded copper conductor it is about 96% of the speed of light, whilst in a typical polyethylene insulated coaxial cable it is in the region of 50% of the speed of light.

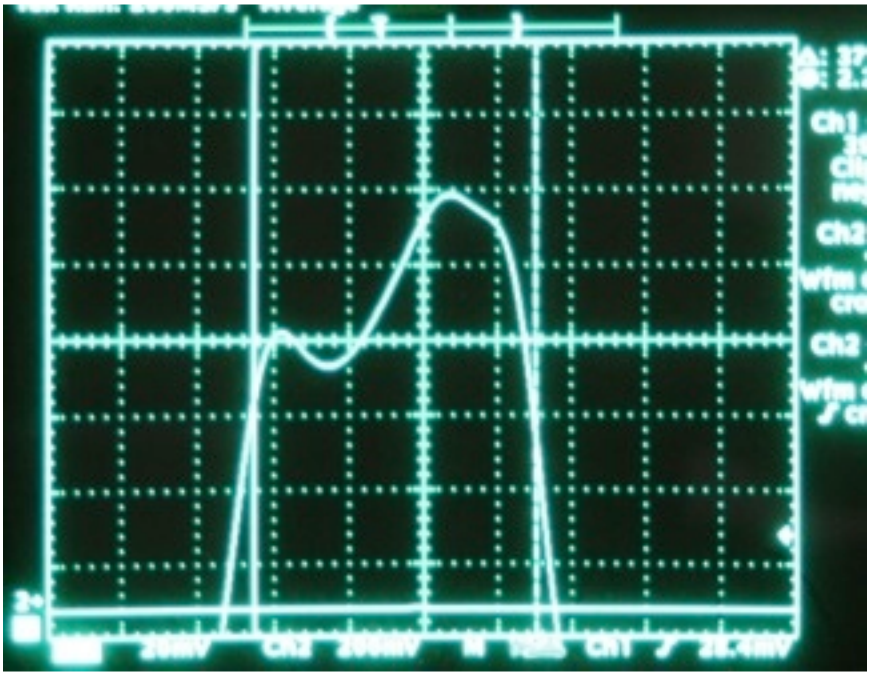
In the broadcast industry cables are often defined by their Velocity of Propagation (VOP) which is calculated using the equation:-

$$v = \frac{1}{\sqrt{\kappa}}$$

where κ is the dielectric constant of the material, so in a vacuum the VOP will equal 1. For comparison the VOP of a high-performance interconnect cable has been measured at around 0.7 and that of the Asimi interconnect at over 0.9, a figure which is well on the way to matching the performance of the theoretically perfect free-air insulator.

Measuring the VOP

The Velocity Factor, and hence the VOP, of a cable is measured using a Time Domain Reflectometer which basically measures the time it takes for a pulse to travel down a cable to a matched load at its end and then be reflected back. This reflection can be seen on the screen as an initial pulse step followed by a larger pulse step as seen below in a measurement of an Atlas cable.



The calculation is made as follows. The time taken by the pulse is 14.7 nanoseconds to travel down a 2 metre cable and back so the pulse is travelling at 3.675 nS per metre. The speed of light is 0.2998 metres/nS so a signal in a vacuum travels a metre in 3.34 nSecs. Divide one by the other and this cable can be seen to have a Velocity of Propagation of 0.91.

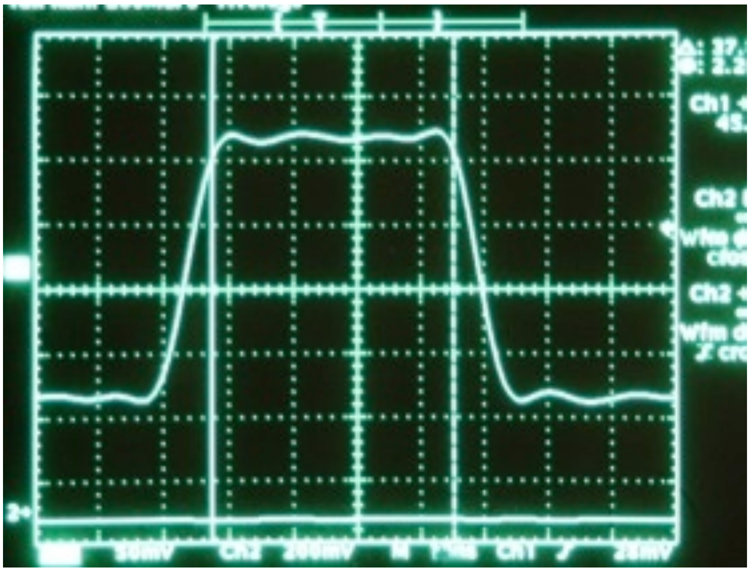
The Manufacturing Process

This Microporous PTFE foam is extremely expensive and cannot be extruded onto a conductor in the normal way and hitherto has needed to be carefully wrapped around the wires like a ribbon. Having no structural strength great care needs to be taken during the construction of the cable to avoid the insulator being crushed when it would revert to being a piece of normal PTFE.

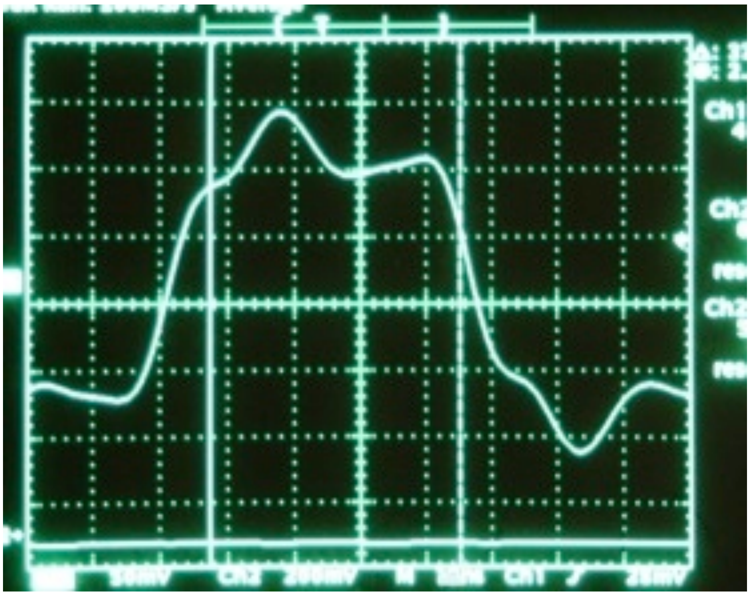
However a new process has been developed which has allowed the Atlas Asimi cable to become a practical reality. Even though it is simpler than winding a foamed PTFE insulator over a conductor the process of extruding foamed PTFE is extremely critical and expensive. First a PTFE paste material is mixed with a finely ground ammonium hydrogencarbonate foaming agent. The mixtures is typically 100 parts by weight of PTFE and 50 parts by weight of ammonium hydrogencarbonate; the exact mix being extremely critical to the process. These mixtures are disolved in a special petroleum spirit and then left to stand overnight so that the petroleum spirit distributes uniformly within the PTFE mix. The resulting paste is then compression molded to give a stick of material and a ram extruder is used to press this through a die (a precise hole in a block of steel). In the centre of the extrusion barrel of the ram extruder there is a mandrel which guides the conductor wire to the die nozzle where the PTFE mixture coats the wire, producing a sheathed cable which is then dried at 160°C. The petroleum spirit escapes and the ammonium hydrogencarbonate breaks down to give low-molecular-weight gaseous substances which also escape leaving a mass of air filled voids.

The Final Result

Ultimately the listener will make his or her own judgement of the success Atlas have achieved with the Asimi interconnect cable. Our extensive work has shown the Asimi to be a near-perfect conductor of electrical signals with a smooth and extended frequency response as can be seen from the comparison of the two signals below which show the transmission of high-frequency signals. The output from the Asimi cable is a near perfect replica of the input pulse whilst the output of the other cable (an expensive and well reviewed cable from one of our competitors) can be seen to heavily distorted due to it having a complex impedance which caused different frequencies to get out of step with each other.



The Asimi interconnect cable



The Alternative interconnect cable

With the Asimi Atlas Cables has engineered a outstanding wideband audio cable which has made a major and measurable step closer to the theoretical ideal of the perfect cable. This has required a dramatic improvement in cable technology and manufacturing methods but we feel that every listener will hear the benefits every time they listen to their music.