



Performance Range



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Introduction

Performance forms the first part of a new simplified concept of speaker cables and interconnects from QED. The new collection is organized in to a logical hierarchy rising in price, cross-sectional area and material refinement from the convenient and cost-effective Performance through Reference and Signature right up to the uncompromising and exclusive Supremus level. There is a only a single speaker cable or interconnect in each category of the four ranges, all sharing fundamental design considerations born out of our Genesis Report first published in 1995 and making product selection easier for the consumer.

Here we detail the features and benefits of the new QED Performance Range of cables designed to enhance the fidelity of all budget and mid-range hi-fi systems.



Performance Speaker cable



Features & Benefits

- Large 2.5 mm² CSA for low d.c. resistance
- X Tube Plus Technology™ for linear current distribution at all frequencies
- Low-loss LDPE Dielectric for enhanced signal propagation
- Five nines oxygen free copper (99.999%) for superior conductivity
- Factory fitted Airloc plugs and spades provide a low-noise, high conductivity connection for life
- Flexible figure eight construction for ease of use and simple termination

Low DC Resistance

At QED we recognise that low d.c. resistance of the loudspeaker cable is of paramount importance for high fidelity signal transfer. This is because the speaker presents a frequency dependent load to the amplifier of which the cable forms a variable proportion. If resistance is too large, audible changes to the frequency response characteristics of the loudspeaker will be introduced which cannot be corrected for by the amplifier's negative feedback loop. At QED we have determined that a cross-sectional area of at least 2.5 mm² is required in our cables to guarantee that the effects of cable resistance on loudspeaker response remains negligible (*see (a) Fig. 1*). This size was first applied to the legendary QED 79 strand, arguably the UK's first hi-fi oriented loudspeaker cable and so chosen for our entry level QED Performance Speaker cable. The benefits of a relatively large cross-sectional are combined with QED's exclusive use of 99.999% oxygen free copper so that the superior conductivity of the cable can be guaranteed for the lifetime of the product.

Low-Permittivity, Low-Loss Dielectric

It is not generally appreciated that the electrical signals moving at or near the speed of light in a wire do so via the medium of electromagnetic (EM) waveforms which propagate within the dielectric surrounding the conductors, as well as within the conductors themselves. The movement of electrons along the conductor merely *facilitates* generation of the EM waveform and it is *this* which conveys the electrical power from amplifier to speaker. Thus, it is important to ensure that the dielectric material used to insulate and protect the central conductors of the speaker cable is of a type which allows the establishment of EM waveforms without appreciable loss. Dielectric losses are directly proportional to the "relative permittivity" of the material used and as this a measure of each material relative to that in a vacuum it should be as low as possible. Like its predecessors, QED Performance Speaker uses a specially

formulated low-density polyethylene LDPE dielectric (see (b) Fig. 1) which at 1.69 has the lowest relative permittivity practically available. QED research has shown that low capacitance cables are generally preferred in listening tests over high capacitance counterparts, usually because low-loss dielectrics have been utilised. The use of LDPE and careful control of conductor spacing (see (c) Fig. 1) results in a cable with a very low capacitance per meter and a “dissipation factor” (the scalar measure of the ratio of loss in the dielectric) of just 0.0004 at 10 kHz.

X-Tube Plus™

As frequency increases, electrons will increasingly flow towards the periphery of the conductor and so only a very thin layer (or skin) on the outside of the conductor is available to the current at high frequencies. This “skin depth” will vary for different materials at a fixed frequency and so in copper with 0.66 mm² cross-sectional area or greater, not all of the area is available for an analogue music signal to utilise. In addition, for a.c. signals in speaker cables, the send and return currents are carried in conductors which are next to one another and because of this, the resulting dynamic magnetic fields induce eddy currents which force the signal current to flow better in the region where the two conductors are closest to one another. This “proximity effect” adds a further detrimental influence on current distribution within the speaker cable, depleting the current density at the periphery.

QED Performance tackles both the proximity effect and the skin effect by combining our existing Aircore™ and X-Tube™ Technologies into a new geometry we call X-Tube Plus Technology™.

By forming the conductors into a tube-like shape with a hollow centre, current densities at different frequencies are maintained because the electric field which contributes towards the skin effect is strongest at the geometrical centre of the whole conductor. In this case, the conductive material in that area has been removed (see (d) Fig. 1) and replaced by a hollow LDPE tube so electron flow can utilise all of the available copper surrounding it.

At the same time the ring of conductors is formed into separate bundles loosely connected which are then twisted into a 90mm lay (one twist around 360 degrees every 90 mm) so that no single conductor bundle remains on the inside or outside of the cable (and therefore prey to the proximity effect) for long enough for it to become an audible problem (see (e) Fig. 1).

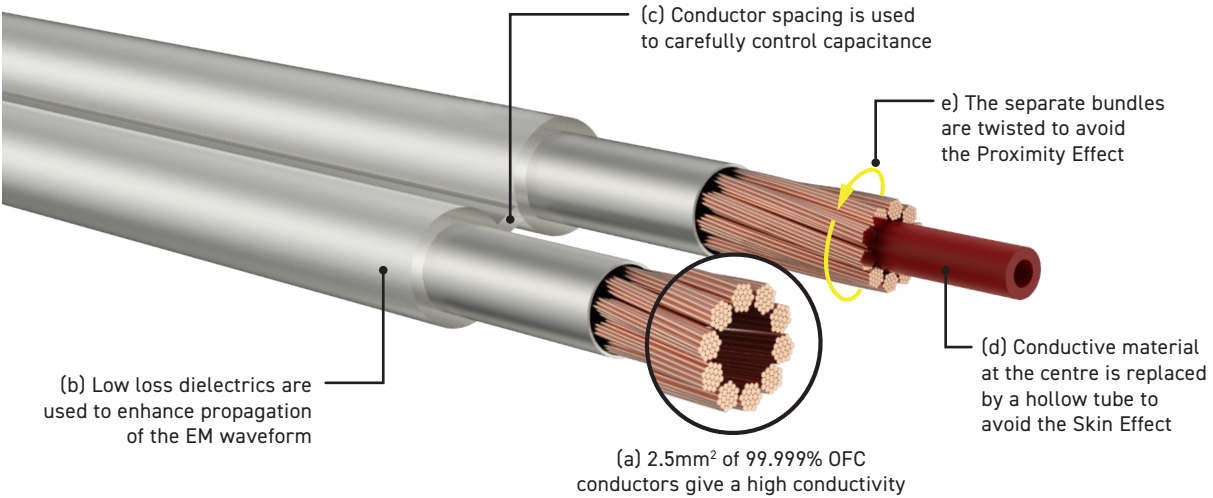


Fig. 1 Anatomy of QED Performance Speaker Cable

New Performance Airloc™ Plugs

Airloc™ is a form of cold weld system that permanently attaches QED Performance banana plugs and spades to QED Performance Speaker cables when bought as a pre-terminated set or in custom lengths from an authorised QED dealer. One of the main reasons for choosing a QED speaker cable is the superior d.c. resistance characteristics offered by our exclusive use of 99.999% oxygen free copper conductors. It seems a shame to ruin this advantage by neglecting the most vulnerable area of the speaker cable chain, that of the physical interface between cable and amplifier or speaker terminals.

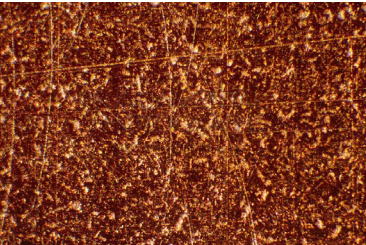
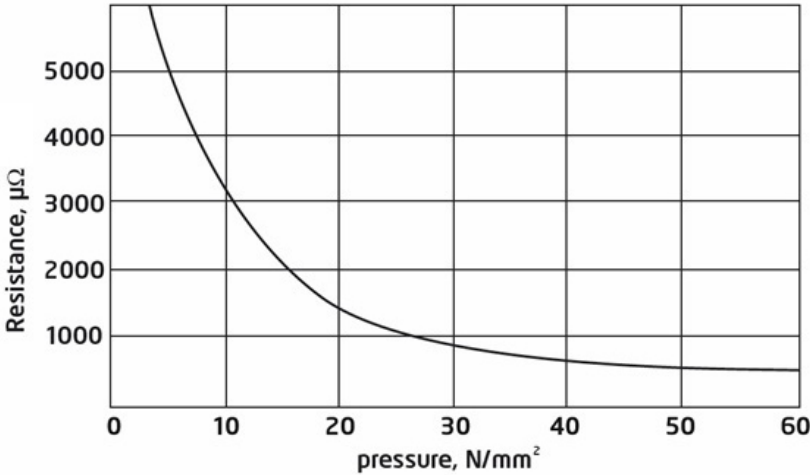


Fig. 2 Rough surface of copper as seen under a microscope

Seen under a microscope the surface of a typical copper strand (Fig. 2) is very rough and so using normal screw type terminals (as found on binding posts or cheap banana plugs), electrical contact is only made in a relatively small number of places, significantly increasing contact resistance. Oxidation is inevitable if copper is exposed to the air for even a short time, and the combined resistance of the cable and its termination can creep back up to levels present in an inferior cable. By using a cold weld crimp type termination, the Airloc system squashes the conductors and plug together to create a homogenous contact area and reduce resistance. As can be seen in the graph below, by the time the full pressure has been applied the resistance of the joint has reached a minimum value. Now, because all the air has been removed from the joint there will be no oxidation of the contact surfaces so the low resistance characteristic will remain for the lifetime of the cable.



During the cold weld process the cable and plug become one solid piece of metal (Fig. 3). Since the copper contact has been effectively removed from the resistance equation we can concentrate on the plug to terminal resistance.

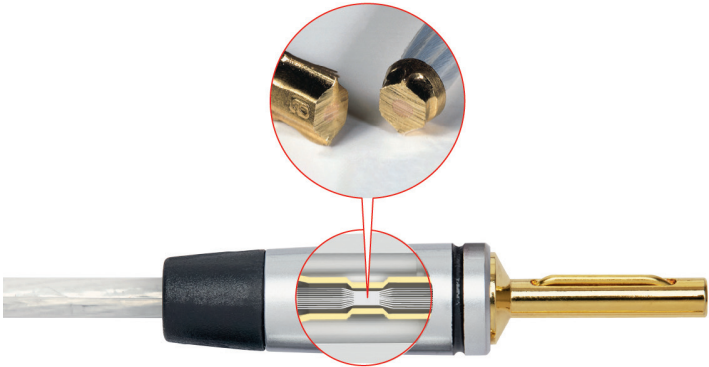


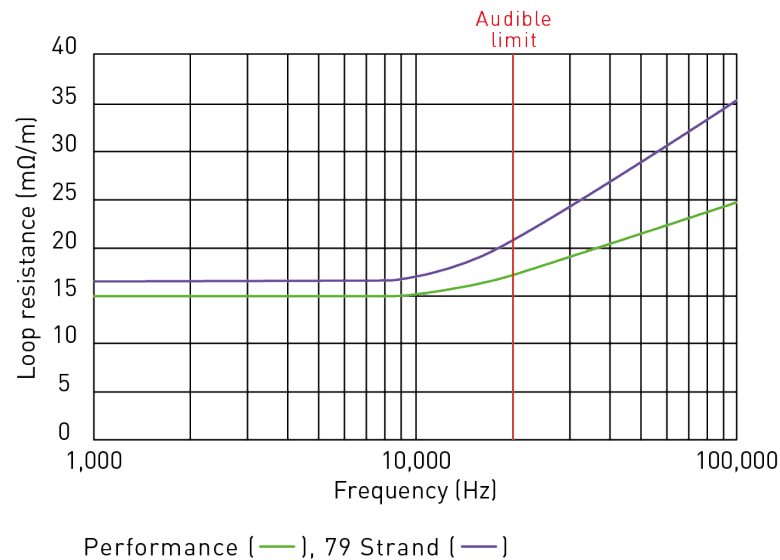
Fig. 3 The cold weld process forms the conductors and plug into one solid piece

The plugs themselves are made of solid brass which has roughly twice the resistivity of copper. For this reason, our 4mm banana plug and spades were designed so that their cross-sectional area is at least double that of the cable to which they are connected, effectively cancelling out the extra resistance of the plug material. QED then plates the connector with high purity gold which has a resistivity almost as low as copper but importantly does not oxidise in air. The relatively smooth gold surfaces provide a larger contact area than uneven copper strands in the cable. Additionally, the contact surface remains clean and low resistance for life due to the non-oxidising nature of the gold plating. The new Performance plug pin section is designed to maximise contact area throughout the wide tolerance range encountered in 4mm amplifier and speaker sockets. Some sockets are quite tight whereas others are loose, so the spring-loaded Performance blade is designed to fit into smaller and larger sockets with equal insertion force. This means that the contact area is maximised and the connection remains uniformly tight. The plug barrels are finished in an extremely durable acrylic lacquer similar to that used in the musical instrument industry. The lacquer has an extremely high voltage withstand and will not wear off, keeping the plugs electrically isolated from one another and attractive for the lifetime of the cable assembly.



What is the result of all these technological features?

The graph below shows how the dc resistance of QED Performance Speaker remains effectively unchanged across the entire audible frequency band when compared to an ordinary cable of the same cross-sectional area e.g. QED 79 strand. The combined improvements brought about by X-Tube Plus Technology, Airluc cold weld plugs, a low-loss dielectric and high conductivity copper, place the new cable in a unique position to greatly exceed the performance of its own illustrious stable mate.



Investing in QED Performance with QED X-Tube Plus Technology™ speaker cables clearly shows a significant performance improvement over stranded copper cable with the same cross-sectional area.

Performance Audio Interconnect



Features & Benefits

- Solid Complementary Conductors for accurate timing of analog signals improving sound staging and impression of scale
- Ferrite impregnated absorption layer protects the delicate analog signal from modern digital noise pollution, lowering noise-floor and improving resolution.
- Foamed polyethylene dielectric reduces capacitance and ensures a low-loss environment for high input impedance analogue signals
- Ultra-flexible TPE outer jacket for increased immunity to microphonic handling noise
- High-quality, gold-plated QED phono plugs provide a low-noise, high conductivity connection for life

Complementary Conductor™ Technology

The cordage is primarily designed for low capacitance, having been identified by QED as a major factor leading to a hi-fidelity experience, making for a tight and engaging sound accurately conveying the timing of the original musical piece. To this end special attention has been paid to the dielectric materials and conductor geometry to reduce capacitance compared to ordinary cables.

Low dielectric-constant materials such as foamed polyethylene have been used throughout, cutting down audio signal energy losses.

Further unique steps have been taken to improve propagation and timing of analogue signals. Performance Audio features Complementary Conductor™ technology which utilises two, solid and electrically-isolated 99.999% oxygen-free copper conductors of different diameters, as opposed to a single multi-stranded one. Using two wholly separate solid conductors carrying the same audio signal, combines the best qualities of two different cables which appears to have the effect of providing an improved alternative route for components of the audio signal which might otherwise become time smeared in a single audio pathway.

All these measures have been applied after consultation with leading academic experts.

We have been able to measure the effects of these improvements using our ultra-high frequency cable test suite. The two diagrams of Fig. 4 show the different jitter measurements in a UHF data stream applied to a cable with a single stranded conductor (*left*) and with two solid conductors of differing diameters (*right*). It is clear that Performance transmits the square wave with more consistent timing (less blurred) and with improved definition (steeper rise and fall). The ability to accurately transmit such high frequency impulses implies that within the audio band, improvements in timing and dynamics may be improved.

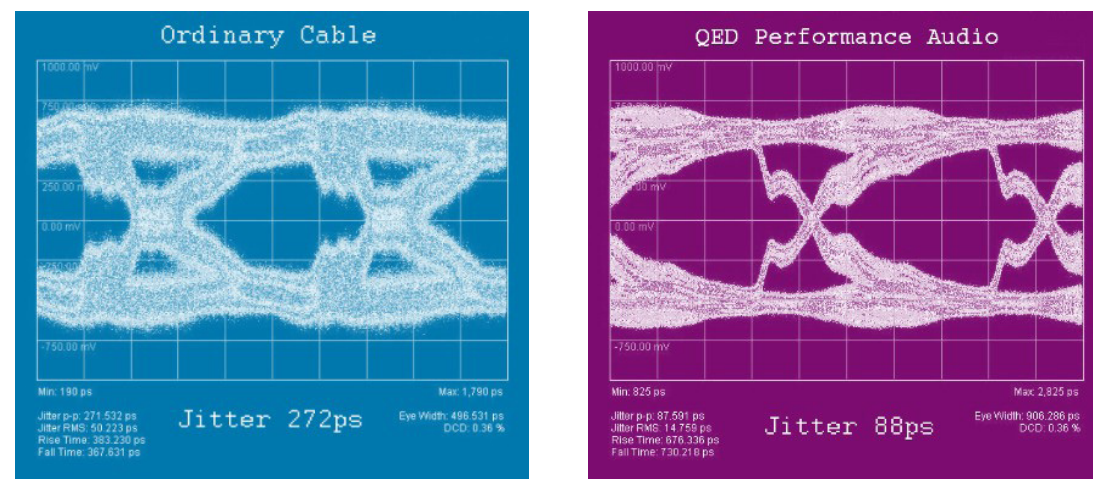


Fig. 4 The Performance cable exhibits significantly lower jitter due to its Complementary Conductor Technology design features

Ferrite Impregnated Absorption Layer

Performance Audio features a specially impregnated absorption layer containing 10% Zinc / Manganese (Zn/Mn) ferrite material. This attenuates very high frequency noise signal components which are thought to have an adverse effect on the micro-timing of the audio signal. There are many such sources of electrical noise in the modern home, all having the potential to disrupt our perception of audio in subtle ways. QED Performance Audio has been deliberately augmented to tackle this problem. It incorporates our unique integral ferrite-impregnated inner layer which wraps the Complementary Conductors in a blanket of radio silence. The uniform distribution of ferrite material throughout the whole length of the cable has been found to be extremely effective at absorbing high frequency noise signals that can affect our listening enjoyment. In the investigation shown in Figure 5 we subjected an ordinary interconnect cable to an RF spike centred on 440 MHz and then measured the output to detect the fundamental frequency and any related harmonics being picked up by the cable.

It is easy to spot both the original 440 MHz signal and a sub harmonic at 220 MHz in the figure. Next, we repeated the experiment, this time using QED Performance Audio cable with the ferrite impregnated layer.

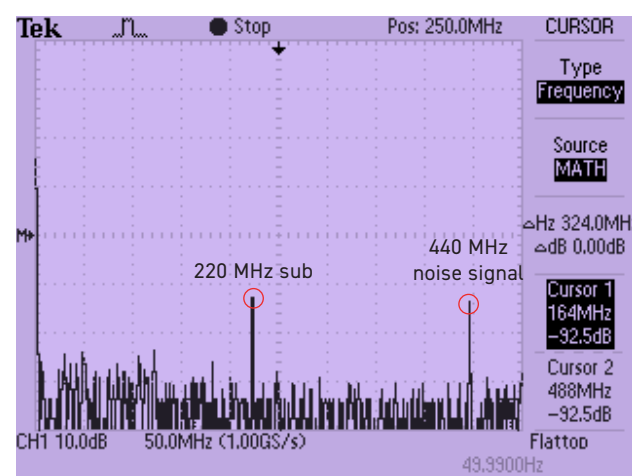


Fig. 5 RF performance of an ordinary interconnect cable

It can be seen in Figure 6 how the fundamental frequency has been usefully lowered by roughly one division and that the harmonic frequency has been completely suppressed by the ferrite layer. It is important to note that the magnitude of the artificially induced spike was far greater than any real-world signal would be, but it is a useful illustration of how effectively the RFI protection added to the cable performs in this crucial audio environment.

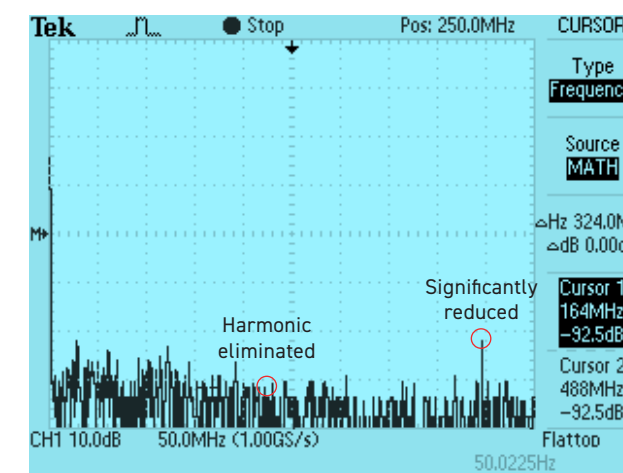


Fig. 6 RF performance of QED Performance Audio with ferrite layer

Flexible Thermoplastic Elastomer (TPE) Outer Jacket

The Performance cable range has been upgraded to TPE rubber construction. TPE has been carefully chosen due to its quality feel, improved flexibility, extended longevity, as well as reduced microphony. If a cable jacket is allowed to vibrate excessively when exposed to airborne soundwaves, the varying capacitance of the cable can act as a microphonic pickup. For QED Performance this could undo any advantage contributed by the excellent timing characteristics of the Complementary Conductors. TPE also exhibits a lower triboelectric effect than PVC and so static generated by external acoustical vibration and handling is reduced leading to even less noise being introduced into the signal path. By using TPE the enhanced mechanical insulating properties of the cable jacket bring extra reassurance that the benefits of Complementary Conductors and Ferrite Absorption Layer will be maintained in all environments.

Gold-Plated QED RCA Plugs

Performance cables are finished off with a newly styled and attractive RCA plug with brushed alloy-look barrels. The plug bodies are made from high-copper brass for best conductivity and are machined individually to the highest tolerance to provide a secure yet gentle push-fit. All electrical contacts are gold-plated to two microns to create a tarnish-free, noiseless connection for life.

Conclusion



QED Performance Audio, in common with the other interconnects in the new Performance Range brings a new level of excellence to the budget hi-fi cable market. Incorporating high-end concepts such as Complementary Conductor Technology and Ferrite Impregnated jackets, which were previously a staple of more costly cables. The all new TPE outer jacket additionally lends the cables an unprecedented tactile quality alongside improved mechanical-noise immunity.

