XT5 POWER CABLE

With X-Tube™ Technology

The Sound of Science

Introduction

QED is proud to introduce the XT5 power cable, the first of a new generation of audiophile mains cables intended to complement its award winning range of speaker cables and audio interconnects. The cable features a number of proprietary technologies applied with reference to objective scientific research and subjective evaluation, to bring a functional improvement in performance.

QED's philosophy

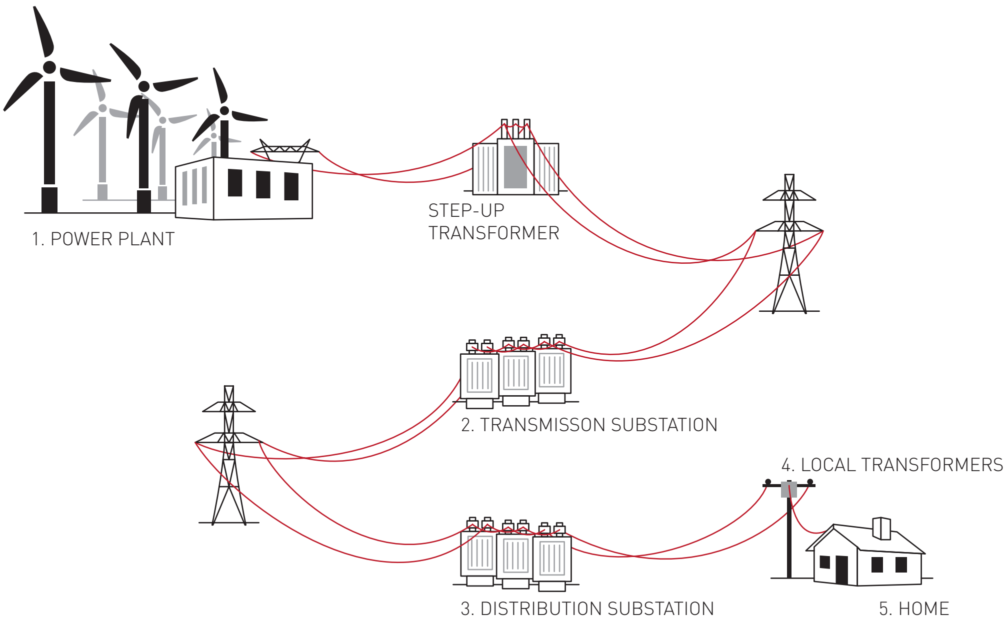


Figure 1. Typical domestic mains supply route

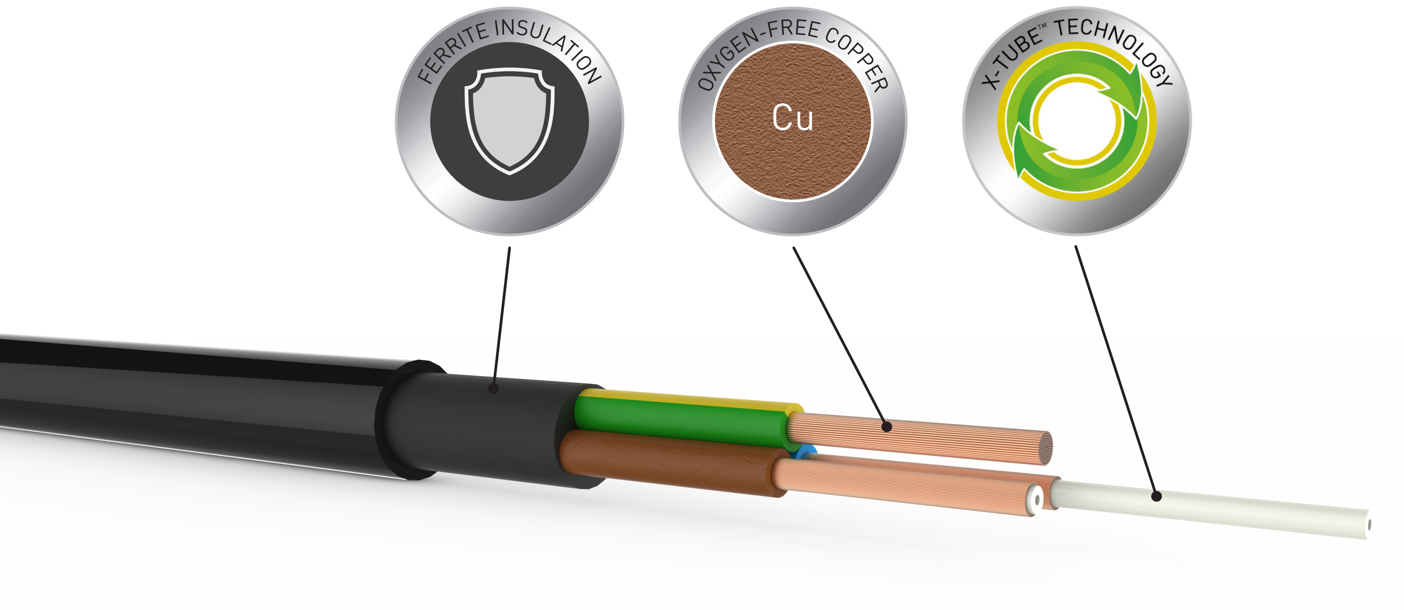
How can power cables make a difference?

With many kilometers of power cables between the power plant (1) and the local distribution sub-station (3) and hundreds of metres between there and the domestic dwelling (5) the obvious question is how can two metres of mains cable make a difference to the sound of hi-fi equipment?

Well, the main reason is that due to its small cross-sectional area the cable forms a bottle neck for the smooth transfer of current to the domestic device in the home. Electrical energy is transferred from the power station to the sub-station at very high voltage and low current so power losses are kept to a minimum.

Once the voltage is stepped down to the low-voltage, high-current domestic supply (4), more power can be lost in the cables over the last few metres than the previous tens of kilometres, so proportionately thicker cables are necessary. Inside the home a typical UK 32 amp ring main uses large cross-section copper cables wired in parallel (equivalent to 5 mm^2) to achieve a large current carrying capacity. Although successful at reducing losses these would be too bulky and impractical to use with domestic equipment which is typically connected to the mains using thin flexible cables of sometimes no more than 0.5 mm^2 cross-sectional area. This is fine for something like a table lamp but it can be problematic for something more complex like an amplifier or CD player.

Features



QED XT5 with X-Tube™ Technology

It is well documented, that for parallel conductors carrying in-phase alternating current (a.c.) in opposite directions, the current density will be greatest in the portions of each conductor which are nearest to each other and much reduced in the portions which are furthest away.

This phenomenon, known as the "Proximity Effect," becomes more pronounced as frequency increases, confining current flow to a smaller and smaller area and causing cable impedance to steadily increase.

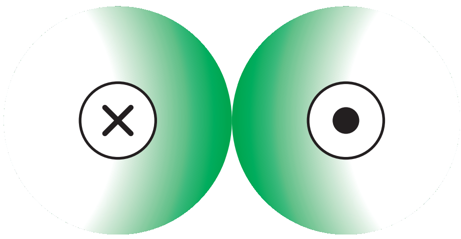


Figure 2. Proximity Effect in live & neutral conductors

At relatively low frequencies such as those found in the mains (50 Hz) the problem only becomes significant in high current applications; but can this really be an issue in a domestic hi-fi mains lead where the current draw is relatively consistent and remains at a frequency of 50 Hz all the time? Well if things were that simple there would be no need to be concerned.

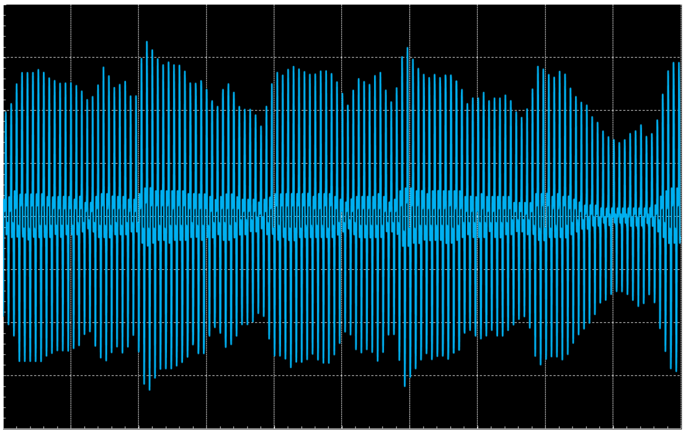


Figure 3. Current being modulated by the output signal in a hi-fi amplifier mains cable

However, the current drawn by a typical hi-fi amplifier playing music at even modest amplitude into an ordinary pair of speakers is anything but simple or consistent, as an oscilloscope and current clamp can reveal. As can be seen in figure 3, current is drawn in small discrete pulsed transients, which sympathetically vary in amplitude as a direct result of the demands of the musical output signal.

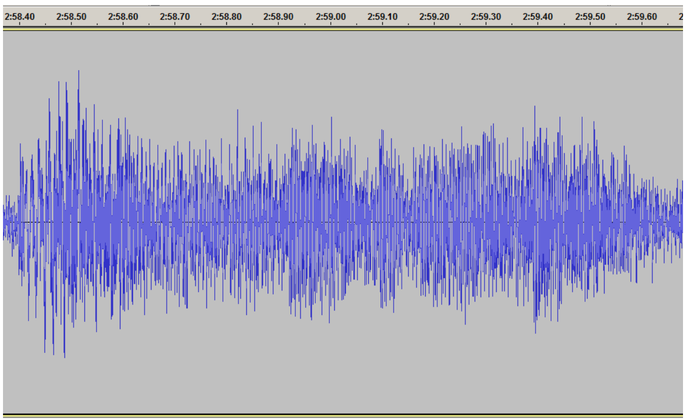


Figure 4. Output voltage at speaker terminals of typical hifi amplifier

Compare this input current trace with the actual musical signal output in figure 4 and it can be seen that variations in the current demanded by the amplifier resemble somewhat those of the output signal.

Although the waveform created by the current demands of the amp would not be very musical to listen to, the transients that the mains cable is likely to encounter cause the same modulation of the cable impedance due to the proximity effect with the same attendant increase in noise and distortion as that found in speaker cables.

It would appear then that even though the power levels are low compared to those encountered by engineers in commercial power generation, many of the techniques used by them to overcome the proximity effect and even-out current distribution in power cables would be applicable to a domestic hi-fi mains cable.

QED have long used bespoke adaptations of these universal ideas in the form of X-Tube™ and Aircore™ Technology to improve the performance of speaker cables and this can now just as effectively be applied to the new power cables.

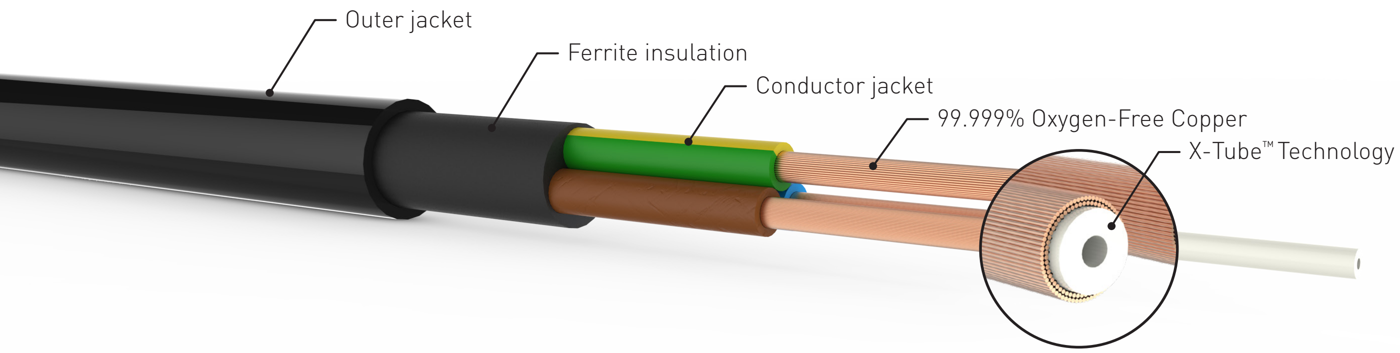


Figure 5. X-Tube™ conductor construction

QED XT5 power cables feature a specially adapted version of X-Tube™ Technology similar to that used in our speaker cables but specifically tuned to be appropriate for this new application. The braided individual cores in the live and neutral conductors are made small enough that they are not affected by the eddy currents from adjacent cores which help contribute to the proximity effect.

Because they are effectively isolated from one another, the carefully calculated twist rate of the strands means that no two conductors remain next to each other in the parallel configuration for more than a few millimeters, further enhancing the even current flow along the cable at all frequencies. The separate bundles are individually insulated using K130 PVC to control cable capacitance and provide the level of electrical isolation demanded by international safety standards. The whole arrangement is provided with a hollow LDPE core to control cable inductance. In this way the correct phase relationship between voltage and current is not altered by the cable parameters, further decreasing distortion when compared to an ordinary mains cable.

The graph below shows how little the impedance of a QED XT5 mains cable changes with increasing frequency compared to an ordinary mains cable of the same cross-sectional area. It also shows how the effective cross-sectional area of the XT5 cable diminishes much less rapidly with increasing frequency than that for the standard cable.

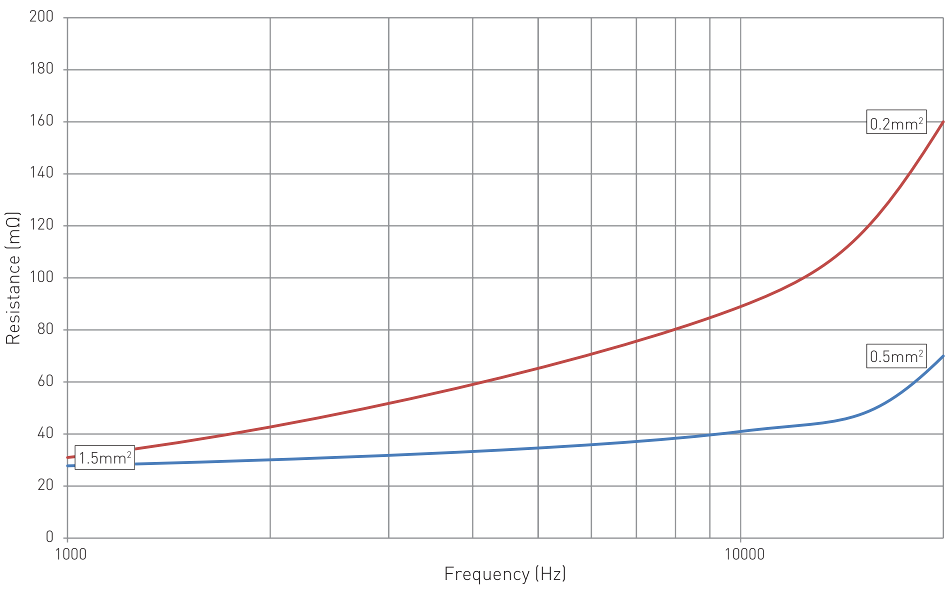


Figure 6. Graph of resistance versus frequency for QED power cables
Standard cable (—), QED XT5 power cable (—)

The effect of X-Tube™ Technology on the sound

In order to find out how the smoother impedance characteristic of the new mains cable can improve the sound of even ordinary audio equipment, we measured the audible noise-floor generated by a typical integrated-amplifier whilst playing various real world musical signals. The results were very interesting. The graph of figure 7 shows the audio noise floor generated by the amplifier when using QED XT5 mains cable (purple) compared with that using an ordinary mains cable (yellow). In both measurements the same passage of music was used. There is a useful improvement in audio noise floor across the whole audible spectrum of up to 10 dB. Note how the new cable even provides an exceptionally useful improvement at the mains hum frequency of 50 Hz, a benefit which would be appreciated even in more expensive equipment.

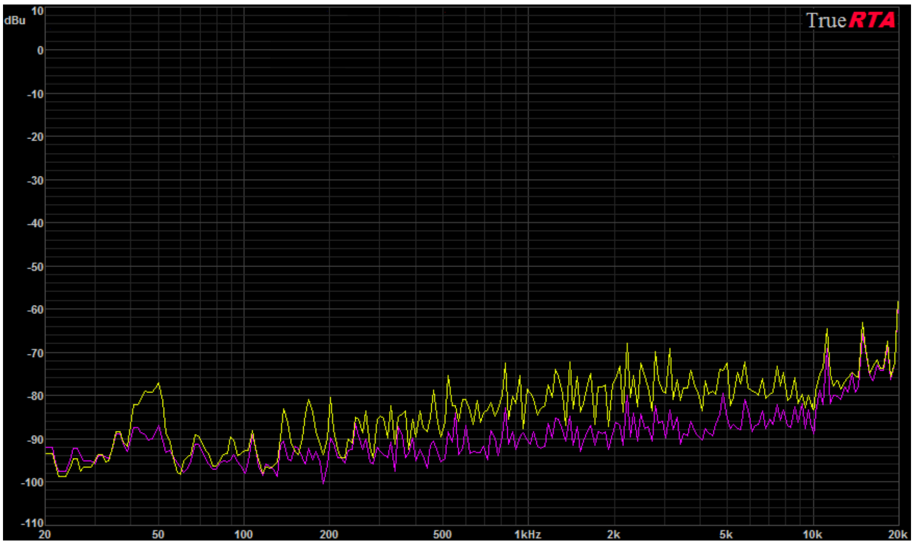


Figure 7. Ordinary power cable (—), QED XT5 power cable (—)

Ferrite Insulation

As we know the domestic mains supply is not all that clean. Theoretically it is supposed to be a simple 50 Hz sine wave but the ideal waveform is already distorted with higher frequency components by the time it reaches the domestic outlet.

Add to this, radio frequency noise in the home injected onto the mains by computer equipment both intentionally (ethernet over mains) and unintentionally (badly designed equipment with marginal EMC compliance) and it's easy to see how even the most diligent audiophile's hi-fi system might become corrupted by mains borne interference.

QED XT5 has been deliberately augmented to tackle this problem. It uniquely incorporates an integral ferrite-impregnated inner jacket which wraps the X-Tube™ cores 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 and this phenomenon has been exploited already by QED in the successful Audio 40 range of analog and digital interconnects with which QED XT5 mains cable is completely compatible.

In the investigation shown in Figure 8a we subjected an ordinary mains cable to an RF spike centred on 440 MHz and then measured the output of the cable using a Fast Fourier Transform to detect the fundamental frequency and any related harmonics being picked up by the cable.

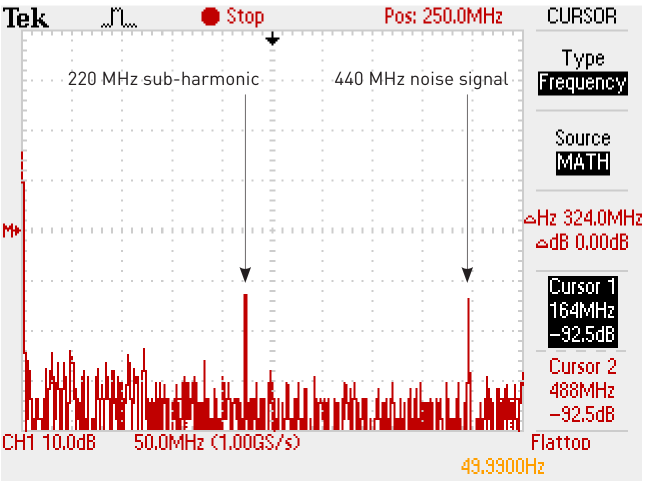


Figure 8a. RF performance of ordinary power cable

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 but this time we used the QED XT5 cable with the ferrite impregnated jacket.

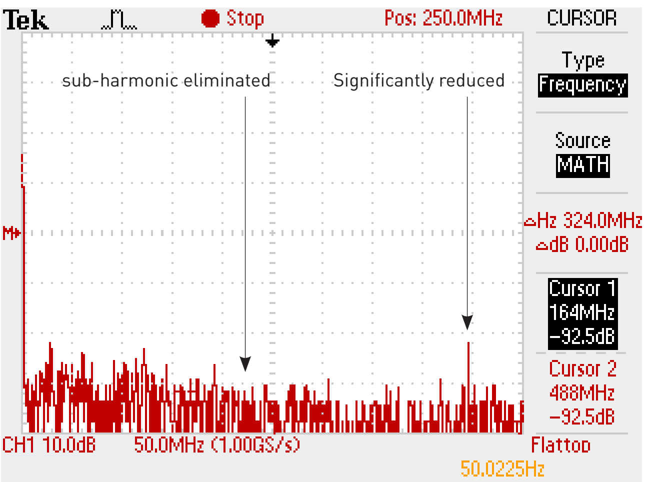


Figure 8b. RF performance of XT5 Power Cable with ferrite jacket

It can be seen in figure 8b how the fundamental frequency has been usefully lowered by roughly one division and that the harmonic frequency has been completely supressed by the ferrite jacket. 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 XT5 cable performs in this crucial audio environment.

QED XT5 practicality

QED XT5 has been designed to be as thin and flexible as possible and as part of this only the live and neutral cores have been given the X-Tube™ treatment leaving the Earth core (which is only required under fault conditions) in a conventional geometry.

This enabled us to keep to our design goal which was to fit technically superior cordage into standard high quality mains plugs and sockets and this meant keeping the outer diameter within the range specified by the relevant harmonized standards for flexible cables. Because the X-Tube™ geometry enables the whole cross-sectional area of the cable to be available for current flow all of the time, the individual cores could also be kept to a reasonable 1.5 mm^2 which in turn allowed us to make a supremely flexible and convenient audiophile mains cable that won't threaten to lift your amplifier or audio streamer off the floor!

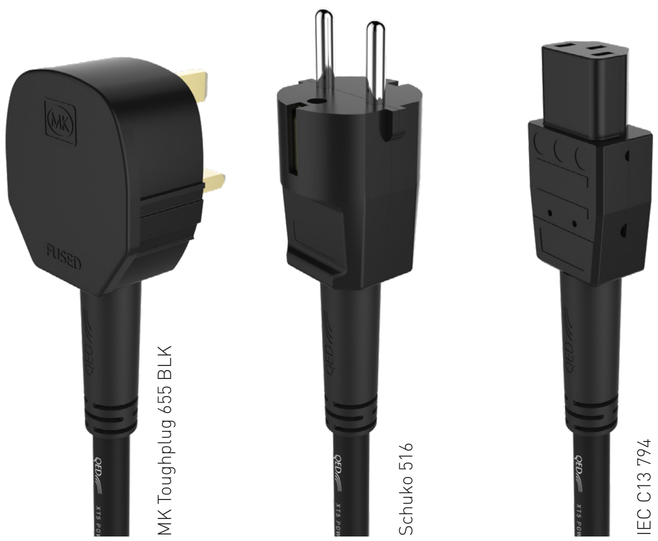
QED XT5 safety & type testing

There are many alternative brands of audiophile mains products on the market but even a cursory investigation reveals that many do not have the full set of required safety test reports and type testing certificates demanded by international legislation.

Rest assured, this is not the case with QED XT5 Power Cables. Because of the constraints which we placed on the design, the cordage fits into standard high quality plugs and connectors which come from leading manufacturers.

In addition to the pre-existing safety certification which comes with these products the completed cord set has been fully type tested to EN 60320, EN 60884 & EN 50525 by an accredited certification body and found to be fully compliant. Regular testing of the product at our production facility as set out in the annex to these standards is also carried out. A full test report is available on request from info@qed.co.uk.

Because fully approved mains plugs and connectors are never supplied as standard with gold plated pins any that you might see for sale have usually been variously modified after manufacture by the reseller. This is not a good idea, as any type-testing certification which might be available for the product will have been invalidated by this process; effectively a new "type" has been created which is not the subject of the test report.



The plugs and connectors fitted to QED XT5 are standard high quality items such as the MK Tough Plug (used in military and health service applications) and as such have not been adulterated in any way by us. However, we do treat all the pins with contact cleaner to protect them from corrosion and enhance the quality of the electrical contact

Conclusion

It is clear that with X-Tube™ technology applied to the QED XT5 Power Cable fewer distortions caused by modulation of the cable impedance will affect current flow to audio equipment and so are less likely to find their way into the music.

Without the XT5 cable to feed them with clean, noise-free current, many amplifiers can sound glassy and hard with less ability to respond to musical transients, giving a lack of dynamics and weak bass performance.

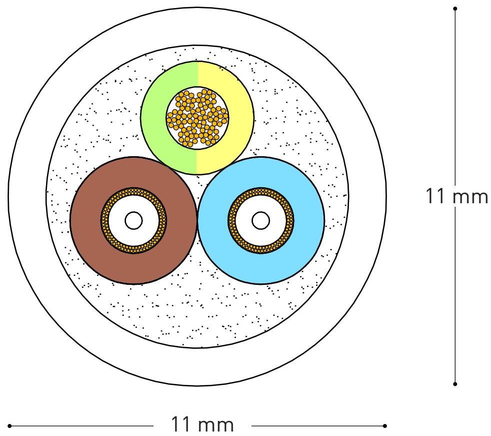
With a clean input current, wrapped in a blanket of radio silence, any haze introduced into the upper detail of the music is removed, giving more air and life to the final musical presentation.

Finally, with the quality assurance of a fully type-tested design, QED XT5 Power Cable can be relied upon to safely bring audible improvements to the sound of any audiophile hi-fi component to which it is applied.

QED XT5 Power Cable - UK 3 pin plug to IEC C13 connector

QED XT5 Power Cable - EU Schuko pin plug to IEC C13 connector

Specification



Conductor type	X-Tube™
Metallurgy	99.999% Oxygen-Free Copper
Cross-sectional area	1.5 mm^2
Ferrite Jacket	10% Zn/Mn
Capacitance	98 pF/m
Inductance	0.52 uH/m
Loop Resistance	0.026 ohm/m
Dielectric Strength	2 kV (ac for 15 mins)
Complies with	EN 50525, EN 60320, EN 60884
Outer Jacket	Black Pearl
Nominal Outside Diameter	11 mm
Plugs	UK: MK Tough Plug 655 BLK; EU: Schuko 516
Connector	IEC C13 794

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