AN004 - C60 Application Note

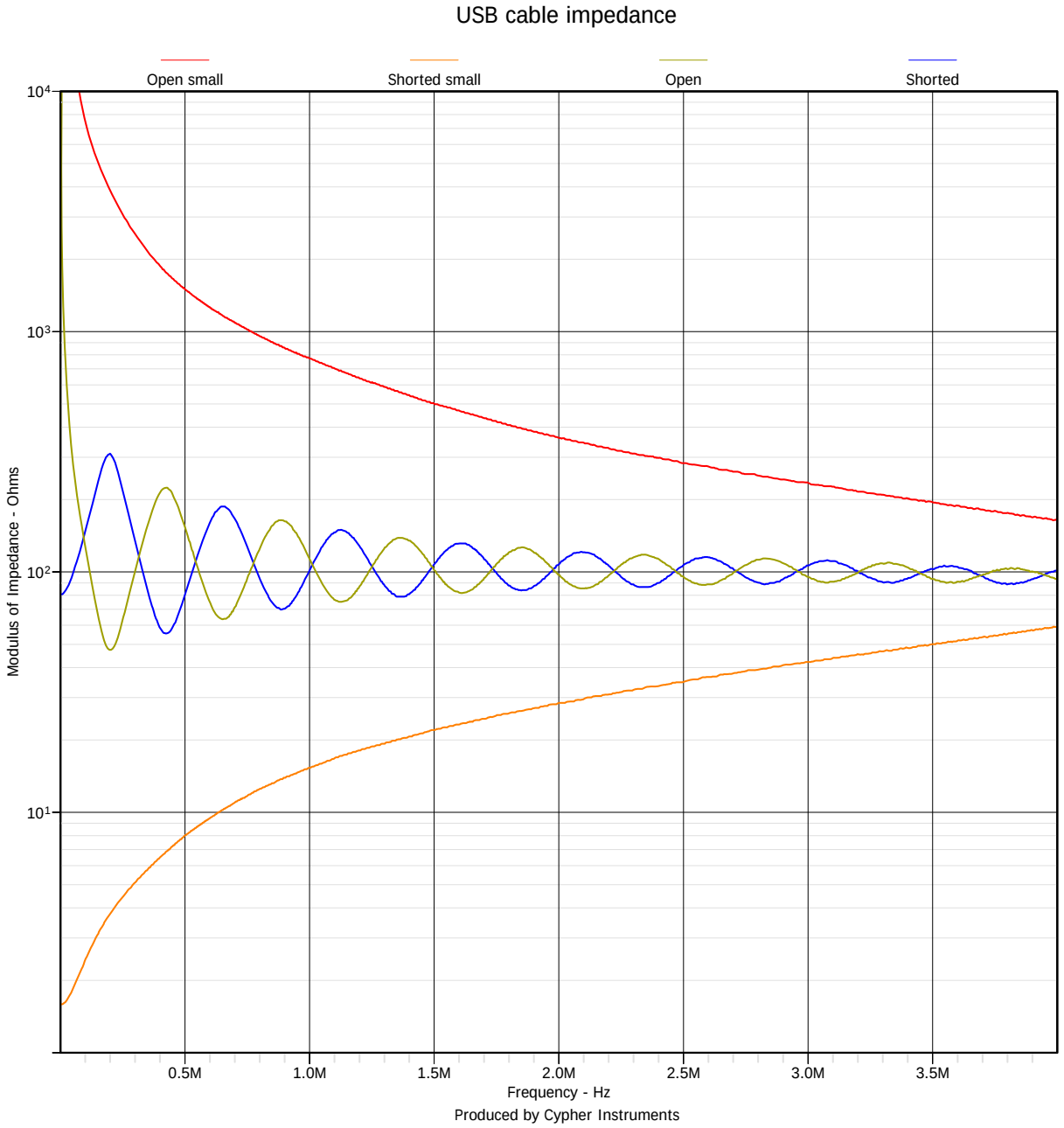

Figure 1. Characteristic impedance of USB cable

Cable impedance measurement

Put two or more insulated conductors together in a long cable and a **characteristic impedance** is formed between them. This is because they virtually occupy the same physical space and so have mutual capacitance and inductance. This impedance is defined by; $Zc = \sqrt{L/C}$, where Zc is the characteristic impedance of the cable and $L \& C$ are the lumped inductance and capacitance per unit length of the cable. As we don't have values for either of these, the formula is only useful to cable designers who have control over the physics of the design. There are two methods of finding out the characteristic impedance of a cable.

- One; it is written on the cable drum and sometimes on the cable.
- Two; if that is too easy for you, then you can measure it.

Method

The cable impedance at high frequencies is defined as; $|Zc| = \sqrt{|Zopen| \times |Zshort|}$.

An impedance test was performed on a 200 metre drum of USB cable and also a short 4 metre length. The far end of the cable is tested open circuit and then short circuit, producing the graph above. The characteristic impedance can be calculated at any test frequency from the formula above or by viewing the graph. Where the open and shorted curves cross each other, that point is the characteristic impedance of that cable length. If the cable length is long enough, the two impedances will converge. This test method can also be used to trim cable lengths for particular wavelengths.

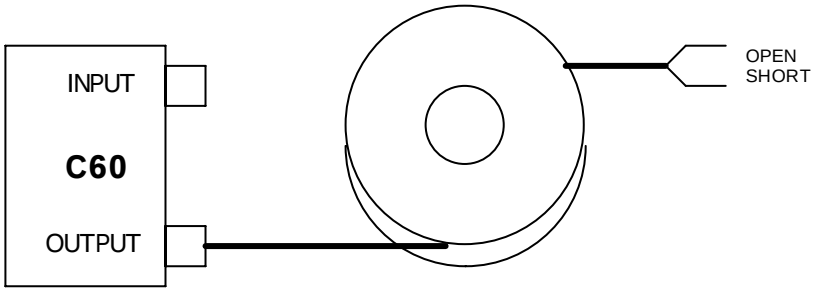

Figure 2. Connection diagram