AN224
Twisted Pair Cable Terminations

Written by Paul DeWinter for
AEA Technology Inc.
www.aeatechnology.com

Abstract

This application note discusses TDR reflection signatures that indicate the electrical end of a cable pair, and fast ways to prove both the electrical end and the physical end are the same point.

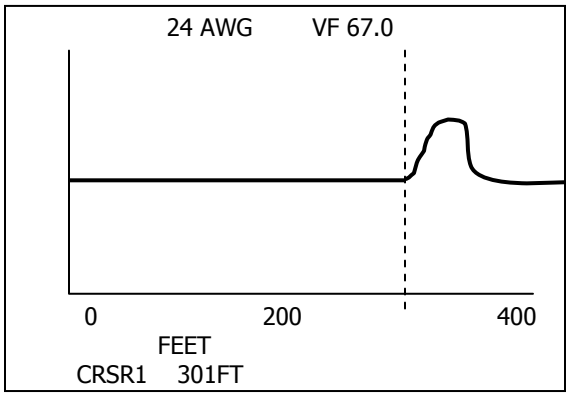
General

The electrical end of a cable and the physical end of a cable may NOT be the same point. A cable pair ends electrically when it reaches a short between the conductors or an open disconnection on either one of the conductors. These events appear differently on pulse and step TDRs as the examples will show.

Electrically Open Cable End

Figures 1 and 2 depict the electrically open end of a cable pair. Figure 1 depicts the end on a pulse TDR and Figure 2 depicts the same open end on a step TDR. It does not matter to the TDR or an AC signal transmitter that one of the conductors continues on in a cable. The pair's impedance (Z) has gone to infinity. On an AC signal transmission media, all remaining energy will be reflected back to the source when it reaches the point where either conductor is open.

Open End – Pulse TDR



Open End – Step TDR

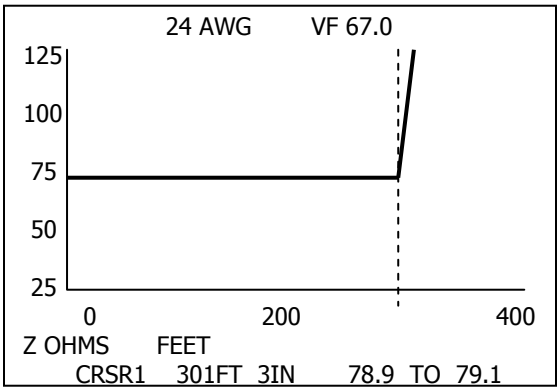


Figure 1

5933 Sea Lion Pl, Suite 112, Carlsbad, CA 92010 ◦ Tel: 1-800-258-7805 +1-760-931-8979 ◦ Fax: +1-760-931-8969
www.aeatechnology.com

Figure 2
Electrically Shorted Cable End

Figures 3 and 4 depict the electrically short termination of a cable. Figure 3 depicts a pulse TDR and Figure 4 a step TDR. Again, the cable could be physically longer, but any point where the pair's conductors make direct contact constitutes the electrical end of the cable. The impedance (Z) will go to zero ohms.

Shorted End – Pulse TDR

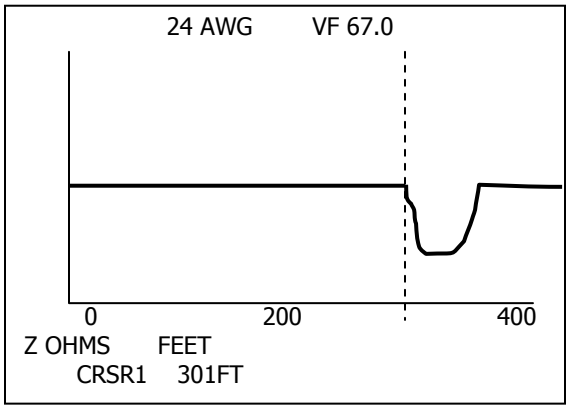


Figure 3

Shorted End – Step TDR

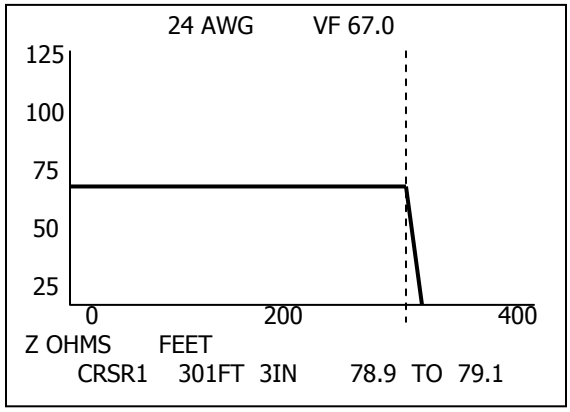


Figure 4

5933 Sea Lion Pl, Suite 112, Carlsbad, CA 92010 ◦ Tel: 1-800-258-7805 +1-760-931-8979 ◦ Fax: +1-760-931-8969
www.aeatechnology.com

Determining Physical End and Electrical End are the Same Point

There is only one sure way to confirm that the physical and electrical end of a cable is the same point. Once the TDR has displayed the end of the cable as an open or short, the user must go to the opposite end of the cable and check to see that the TDR's evaluation is correct for open or short. If it is correct, change the termination to the opposite condition. Then return to the TDR and note that the trace has changed to the open or shorted condition set at the end of the cable and that the distance is the same. This will confirm you are viewing the entire length of the cable.

If the TDR does not change its trace when the end of the cable is terminated in the opposite condition, short or open, then the TDR has detected a fault on the cable at the distance indicated.

Matched Terminations

A matched termination is a resistive device that matches the cable's impedance and connects across the wires in the pair. When a TDR's signal encounters this type of termination, it is absorbed and does not produce a reflection. The TDR trace for either a pulse or step TDR will remain horizontal across the entire display never indicating an end to the cable. A matched termination should be suspected whenever the cable's end is not found at distances well beyond the estimated physical end of the cable.

Cables connected to transmission and receiver equipment will most likely be connected to a matched termination.

5933 Sea Lion Pl Suite 101, Carlsbad, CA 92010 ◦ Tel: 1-800-258-7805 +1-760-931-8979 ◦ Fax: +1-760-931-8969
www.aeatechnology.com