Abstract

This application note discusses TDR reflection signatures that indicate the electrical end of the cable 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 ends electrically when it reaches a short from its center conductor to its shield or an open disconnection on either the center conductor or the shield. 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. 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 a TDR or an AC signal transmitter that one of the conductors continues on in a cable. The cable'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 the center conductor or shield is open.

Open End – Pulse TDR

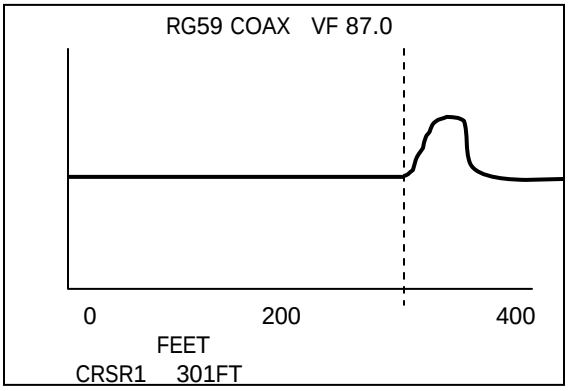

Figure 1

Open End – Step TDR

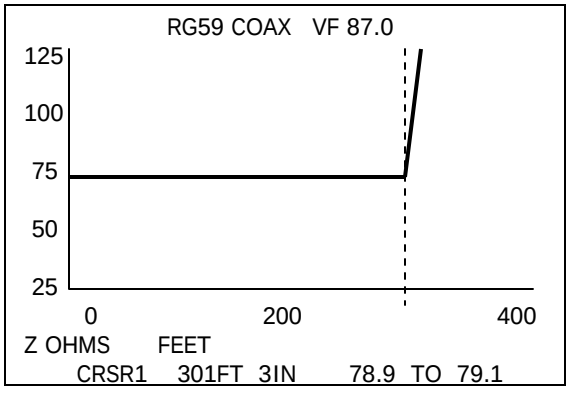

Figure 2

Electrically Shorted Cable End

Figures 3 and 4 depict the electrically short termination of a cable. Figure 1 depicts a pulse TDR short and Figure 2 a step TDR short. Again, the cable could be physically longer, but any point where the center conduct makes direct contact with the shield constitutes the electrical end of the cable. The impedance (Z) will go to zero Ohms.

Shorted End – Pulse TDR

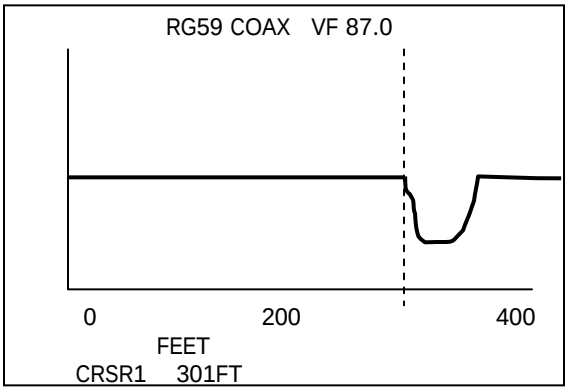

Figure 3

Shorted End – Step TDR

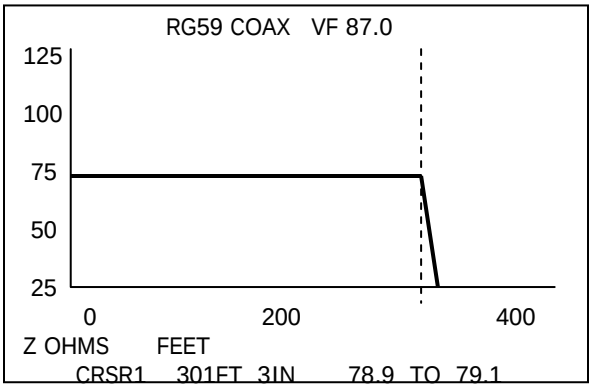

Figure 4

Determining Physical End and Electrical End are the Same Point

There is only one sure way to confirm that the physical and electrical ends of a cable are 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 TDRs 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 the center conductor to the shield. 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. Cables connected to an antenna will appear as an open or as a short depending upon the antenna's design.

Keywords: Measuring coaxial cable termination, Step vs. pulse TDR, locate end of coaxial cable with TDR, coaxial cable open end, coaxial cable shorted end, open termination, shorted termination, coaxial cable termination, open coaxial cable, shorted coaxial cable, measure coaxial cable length

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5933 Sea Lion Pl Suite 101, Carlsbad, CA 92010 ◦ Phone (760) 931-8979 ◦ Fax (760) 931-8969 www.aeatechnology.com