AN210
Coax Cable Resistance

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Abstract

This application note discusses how the resistance of the conductor and shield in coaxial cables affects the impedance plot on a step TDR.

General

When using a step TDR to plot the impedance over the length of a coax cable the trace or plot will be relatively horizontal on the TDR's display for short lengths of cable. As the cable length increases the resistance, particularly resistance in the center conductor, it will cause the trace to "Dribble Up" over its length. This is the result of adding the cable's "Loop Resistance" to the cable's impedance. Loop resistance is defined as shorting the far-end of the cable, conductor to shield, with a zero Ohm short, then using a Ohm meter to read the resistance of the loop from the near-end of the cable.

Normal Dribble Up – Good Cable

A normal or nominal expected amount of dribble up can be predicted by knowing the manufacturer's resistance specification for the coax cable being measured. Manufacturers specify this resistance in Ohms per 1000 feet or Ohms per 1000 meters of cable. As seen in figure 1, a reprint of Belden specifications for a particular coax cable, the resistances are specified separately for the center conductor [Conductor (stranding) Diameter Nom. DCR] and the shield [Shielding Materials Nom. DCR]. The center conductor is 9.9 Ω per 1000 feet or 32.5 Ω per km and the shield is 1.1 Ω per 1000 feet or 3.6 Ω per km.

Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation		
			Ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/Ft.	pF/m	MHz	dB/ 100 Ft.	dB/ 100m
20 AWG Solid .031″ Bare Copper • 98% Tinned Copper Double Braid Shield																			
Polyethylene Insulation • Polyethylene Jacket (Available in Red, Yellow, Green, Light Blue, White, Orange or Black)																			
80°C	8281		500▲	152.4	37.0	16.8	20 AWG	.198	5.03	TC Double	.305	7.75	75	66%	21.0	68.9	1	.3	.8
			1000	304.8	74.0	33.6	(solid)			Braid							3.6	.5	1.8
							.031″			98% Shield							10.0	.8	2.6
							BC			Coverage							71.5	2.1	6.9
							9.9Ω/M′			1.1Ω/M′	For Plenum version of 8281,						135	3.0	9.8
							32.5Ω/km			3.6Ω/km	see 88281.						270	4.3	14.1
																	360	5.1	16.6
											100% Sweep tested. 5 MHz to 850 MHz.						540	6.3	20.7
																	720	7.4	24.3
																	750	7.6	24.9
▲500 ft. put-up not available in White.																	1000	9.2	30.2

Figure 1

To calculate the dribble up over the length of the cable the resistance from both the center conductor and shield must be added to obtain the loop resistance. Using this information we could expect to get an impedance reading at the 500 foot mark of Belden coax, Part No. 8281 of about 55.5 Ω [(9.9 + 1.1 = 11 Ω)/2 + 50 Ω Z_0] This assumes that the initial reading at the TDR was 50 Ω impedance and there were no connections adding resistance between the TDR and the 500 foot mark.

Abnormal Dribble Up or Lossy Cable

If a cable's nominal dribble up exceeds the expected resistive increase by more than 15% it is referred to as "Lossy Cable." The plot in Figure 2 is an example of a good section and a lossy section of coaxial cable. Note the pronounce increase in impedance dribble up in the lossy section from 500 feet to the end of the cable.

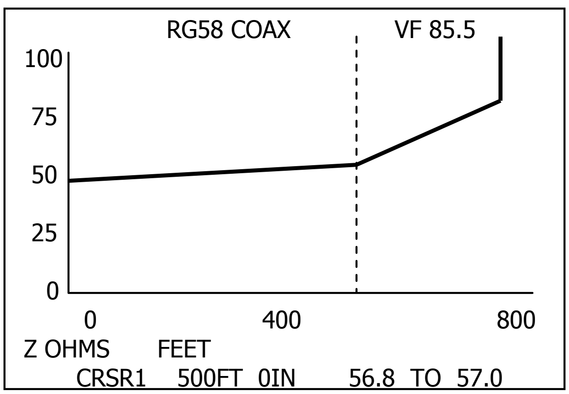

Figure 2

Conclusion

Step TDRs measure a cable's resistance in addition to its impedance. Pulse TDRs are unable to display either of these quantities. The step TDR provides superior capabilities for testing cables and cable losses. The 20/20 Step TDR should be considered by anyone who wants to test cable losses or impedances.

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