Dielectric Properties over Temperature of GORE® Ethernet Cables for Aerospace & Defense

Gore's high-speed data cables are lighter-weight and more durable, giving aircraft system engineers more flexibility during installation. They can also have peace of mind knowing that our cables will hold up in volatile flight conditions — including extreme temperatures experienced from tarmac to altitude.

The unique engineered fluoropolymer materials are the key to our cables' smaller diameter, lighter weight, and excellent signal integrity over extreme temperatures. The expanded polytetrafluoroethylene (ePTFE) in the primary dielectric insulation is proven to have very stable thermal properties.

An important material property of any electrical insulation is the dielectric constant. This property drives the design and determines the impedance and speed of the signal propagating down the length of the cable. The dielectric constant and velocity of propagation can be derived from the scattering parameters (s-parameters) measured over frequency. Specifically, the time delay of a signal propagating down a transmission line can be calculated from the unwrapped phase of the transmitted signal.

Testing & Results

Gore measured the performance of GORE® Ethernet Cables, Cat6A (part number RCN9047-26) over a temperature range of -55C° to 200°C. Specifically, we measured differential s-parameters over a frequency range of 0.5 MHz through 1 GHz at each temperature. The physical length of our 4-pair cable was measured at 13.3 meters (43.5 feet).

The data was analyzed according to SAE AS6070™, and calculations were completed as outlined below:

- Record Sdd21 unwrapped phase in degrees at f = 31.5 MHz
- Calculate time delay (s) from unwrapped phase value

$$td = \frac{-Sdd21\ unwrapped\ phase}{(f*360)}$$

- Calculate velocity of propagation (%) for given cable length

$$Vp\ (\%) = \frac{cable\ length\ (m)}{(td*speed\ of\ light)} *100 = \frac{1}{\sqrt{Dk}}$$

- Calculate dielectric constant (Dk) from velocity of propagation

$$Dk = \frac{1}{Vp^2}$$

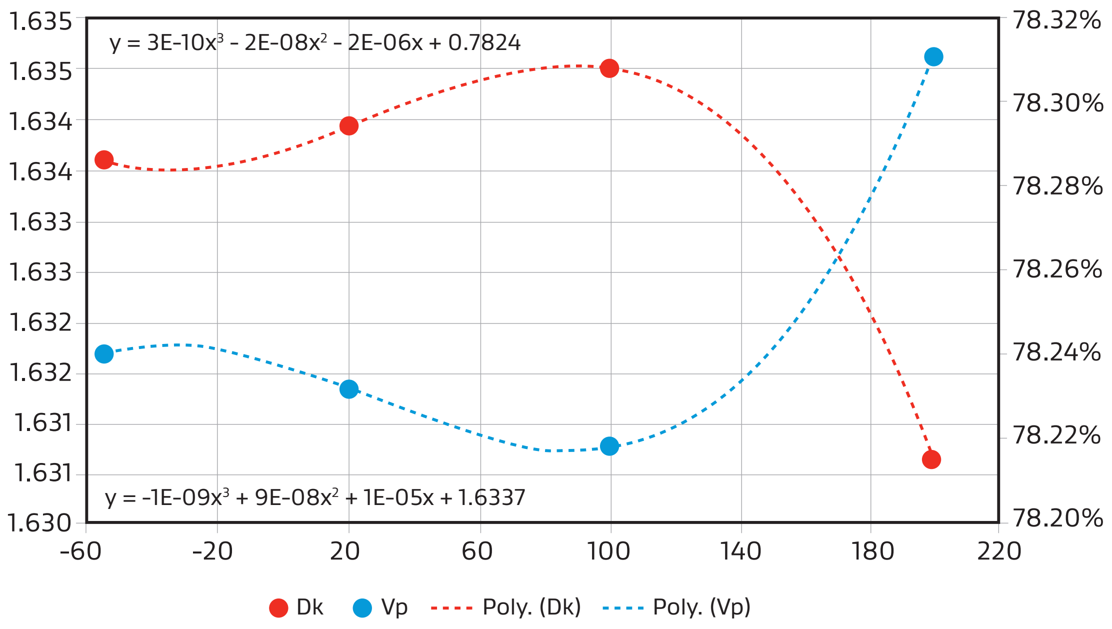
Table 1 shows the velocity of propagation and dielectric constant over temperature of GORE® Ethernet Cables, Cat6A (part number RCN9047-26).

Table 1: Calculated Results for Dielectric Properties over Temperature

Temperature (°C)	Vp (%)	Dk
-55	78.24	1.634
20	78.23	1.634
100	78.22	1.635
200	78.31	1.631

Figure 1 shows the plotted data results and estimated curve-fit for dielectric properties over temperature of GORE® Ethernet Cables, Cat6A (part number RCN9047-26).

Figure 1: Performance Results for Dielectric Properties over Temperature



Conclusion

Test results showed the velocity of propagation of a signal transmitting down the length of GORE® Ethernet Cables, Cat6A (part number RCN9047-26) remains nearly constant with less than 1% variation over a wide temperature range.

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