Measuring the Delay of Calibration Standards

In many cal kits, the open and short measure almost exactly the same electrical delay, even though their published definitions state that the open should have less delay. This is no coincidence, as they are designed to be this way. The open is modeled as a set of capacitances (C0, C1, etc.). These capacitances have the effect of introducing a small electrical delay into the measurement. In the case of the 85033D, the fringe capacitance contributes about 2.55 ps of delay. The length of the offset open delay, 29.243 ps, was selected so that when the fringe capacitance is taken into consideration, the net effect is that the offset open and short standards measure nearly the same electrical length. This is necessary to keep their responses 180 degrees out of phase across the entire frequency range of operation. If this requirement was not met, the phase response of the standards would eventually match at a given frequency. At this point, the valid calibration correction would be indeterminate.

To measure the offset delay, try this: After calibration, put a marker on the trace at 1 GHz. With the analyzer in the Smith Chart display format, activate port extensions. For the 85033D, dial in a port extension of 31.8 ps, and you will see that the trace converges on infinity when measuring the open standard. Look at the marker readout, where it shows inductance and capacitance. Now adjust the port extension until the marker readout shows 49 femtoFarads (this is C0 of the open). The expected port extension value should be near 29.25 ps, the published value.

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