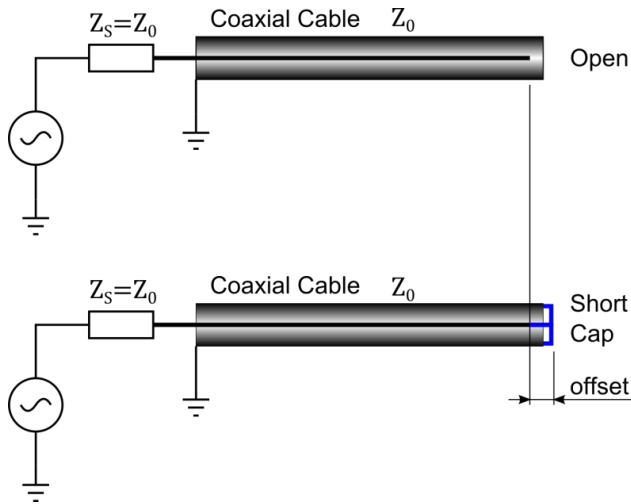


Short Delay Time

When performing the OPEN, SHORT and LOAD calibration with the Bode 100 the user has the possibility to enter a Short Delay Time in the calibration window. This delay time takes the offset between the OPEN and SHORT standards into account as shown in the figure below.



The delay adds a phase shift to the reflection coefficient measured at the short calibration point. The reflection coefficient of the short standard Γ_s taking the delay time T_s into account is given by:

$$\Gamma_s = -e^{-j\omega T_s} \quad (1)$$

The reflection coefficient of the short can be rewritten in impedance form as follows.

$$Z_s = Z_0 \frac{1 + \Gamma_s}{1 - \Gamma_s} \quad (2)$$

Inserting (1) in (2) leads to

$$Z_s = Z_0 \frac{1 - e^{-j\omega T_s}}{1 + e^{-j\omega T_s}} \cdot \frac{e^{\frac{j\omega T_s}{2}}}{e^{\frac{j\omega T_s}{2}}} = \frac{e^{\frac{j\omega T_s}{2}} - e^{-\frac{j\omega T_s}{2}}}{e^{\frac{j\omega T_s}{2}} + e^{-\frac{j\omega T_s}{2}}} = Z_0 \frac{2j \sin \frac{\omega T_s}{2}}{2 \cos \frac{\omega T_s}{2}}$$

$$Z_s = j Z_0 \tan \frac{\omega T_s}{2} \quad (3)$$

For small values of ωT_s this equals approximately

$$Z_s \approx j\omega T_s \frac{Z_0}{2} \quad (4)$$

Hence for small values of ωT_s the short delay time has the same effect like an inductance with a value of

$$L \approx 25 \cdot T_s \quad (5)$$