Calculate the velocity factor Vf from resonance measurements

J. Audet
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c = speed of light in meters/Sec or feet/Sec
λ = wavelength in meters or feet, f = frequency in Hz
Vf = velocity factor (speed in cable / speed of light)
len = length of TRL in meters or feet

$c = 2.99792 \cdot 10^{8} \ \frac{m}{sec}$ $c = 9.83571 \cdot 10^{8} \ \frac{feet}{sec}$

This value will be used for all succeding calculations.

$c := 9.83571 \cdot 10^{8} \ \frac{feet}{sec}$

$\lambda \cdot f = c \cdot Vf$ Basic equation

When measuring Vf, we use a half wavelenght line or quarter wavelenght line

$Vf = \frac{\lambda \cdot len \cdot f}{c}$

λ= 1 for 360 deg resonance (one wavelenght line)
λ = 2 for 180 deg resonance (half wavelenght line)
λ = 4 for 90 deg resonance (quarter wavelenght line)

For a resonance in the half wavelenght mode, we find the value 'len' at freq. 'f' in MHz

$len := 22.167$ $\lambda := 2$ $f := 19.89$ MHz

$Vf := \frac{\lambda \cdot len \cdot f \cdot 10^{6}}{c}$ Eq. (1)

For a resonance in the quarter wavelenght mode, we find the value 'len' at freq. 'f'

$len := 22.167$ $\lambda := 4$ $f := 9.9$

$Vf := \frac{\lambda \cdot len \cdot f \cdot 10^{6}}{c}$ $Vf = 0.892$

Calculate the quarter wave resonant frequency: f4 in MHz

λ = 4 for quarter wave

$Vf := \frac{\lambda \cdot len \cdot f \cdot 10^{6}}{c}$ $Vf = \frac{4 \cdot len \cdot f4 \cdot 10^{6}}{c}$

Solving for f4 in Eq. (1), the quarter wave frequency in MHz:

$f4 := \frac{Vf \cdot c}{4 \cdot 10^{6} \cdot len}$

With c in feet/sec and len in feet

$c := 9.836 \cdot 10^{8} \ \frac{feet}{sec}$ $Vf := 0.66$ $len := 10$ Feet

$f4 := \frac{Vf \cdot c}{4 \cdot 10^{6} \cdot len} = 16.229$ MHz

Note Vf = 0.66 for coaxial cables with polyetylene insulation.

Calculate the lenght in feet for quarter wave resonance

Solving for len in Eq. (1), the length (len) is in feet and (c) is in feet/sec:

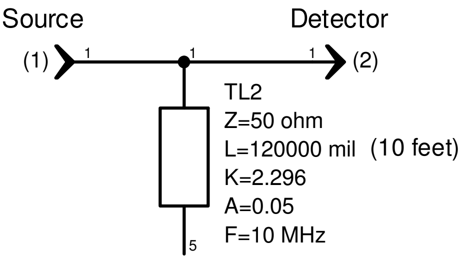
$$len := \frac{Vf \cdot c}{4 \cdot 10^{6} \cdot f4} = 10 \quad \text{feet}$$

f4 is the resonant frequency.

Where c = speed of light in feet/sec.

Simulation

The transmission line under test (TL2) is connected in shunt



With $Vf = 0.66$

The simulation uses K the dielectric constant, instead of Vf

$$K = \frac{1}{Vf^{2}} \qquad K := \frac{1}{Vf^{2}} = 2.296$$

A = attenuation in dB/m at freq. F (MHz)

This end open for quarter wave resonance
This end shorted for half & full wave resonance

The first frequency of minimum response gives the resonnant frequency f4.
As calculated previously len=10 feet