Degrees and Length Calculations

c is the speed of light in megafeet / sec = 983.57 $c := 983.57$
Vf is the velocity factor
f is the frequency in MHz
deg is the line length in degrees
λ is the wavelength in feet
L is the length in feet

The wavelength times the frequency = speed of propagation of signal

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

Solving for λ:

$$\lambda = \frac{c \cdot Vf}{f} \qquad \text{(Eq. 1)}$$

The number of degrees in length L is:

$$deg = \frac{L}{\lambda} \cdot 360$$

Solving for L:

$$L = \frac{deg \cdot \lambda}{360} \qquad \text{(Eq. 2)}$$

Substitute Eq. 1 into Eq. 2, we get:

$$L = \frac{deg \cdot c}{360} \cdot \frac{Vf}{f} \qquad \text{L is in feet}$$

Setting L in inches = Li

$$Li = \frac{deg \cdot c \cdot 12}{360} \cdot \frac{Vf}{f} \qquad \text{Li is in inches}$$

The above may be simplified:

$$\frac{c \cdot 12}{360} = 32.786$$

$$Li = 32.786 \cdot deg \cdot \frac{Vf}{f} \qquad \text{Where Li is the length in inches}$$

Example

$Vf := 0.66$ $f := 146$ $deg := 28.5$

$Li := deg \cdot 32.785 \cdot \frac{Vf}{f}$ $Li = 4.224$ in inches

Setting deg = 360 gives the actual wavelength in inches at freq. f

CALCULATION OF TRANSMISSION LINE PARAMETERS

Ref : http://ve2azx.net/technical/Degrees-Length.pdf

Measured data:

$Len := 0.38$ in. Line length: inches

$C := 2.77$ pF Measure on a short line: < 5% λ
Open the line and measure C

$L := 4$ nH Short the line and measure L

Speed of light in m / sec

$c := 2.998 \cdot 10^{8}$

$$Zo := \sqrt{\frac{L \cdot 10^{-9}}{C \cdot 10^{-12}}} = 38.001$$ Zo is the line impedance

$$L\_ft := \frac{L \cdot 12}{Len} = 126.316$$ nH / feet

$$C\_ft := \frac{C \cdot 12}{Len} = 87.474$$ pF / feet.

$$C = \frac{0.3048 \cdot 10^{12}}{Zo \cdot Vf \cdot c}$$

C in pF / feet
c in m/sec

$$Vf := \frac{0.3048 \cdot 10^{12}}{Zo \cdot C\_ft \cdot c} = 0.306$$ Calculate Vf from previous equation

$$DC := \frac{1}{Vf^{2}} = 10.69$$ Dielectric Constant

Equation relating degrees to line length:

$$Li = 32.786 \cdot deg \cdot \frac{Vf}{f}$$

Li = Line length in inches.
f = frequency in MHz
deg = degrees
Vf = velociy factor

$f := 100$ MHz

$$deg := Len \cdot \frac{f}{Vf \cdot 32.786} = 3.789$$ Degrees at f

$$Delay := \frac{Len \cdot 0.3048 \cdot 10^{9}}{12 \cdot Vf \cdot c} \qquad Delay = 0.105$$ Delay in nSec

$$Delay\_ft := \frac{3.048}{Vf \cdot 2.998} \qquad Delay\_ft = 3.324$$ Delay in nSec / feet