Electromagnetism Practical, Session 1
Transmission Lines

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Assignment 1: Transmission Lines in Frequency Domain

Part 1: Standing Waves in Waveguide

The measured wavelength of the standing wave is 4.4cm. The phase velocity is determined by equation 1. The wavelength in the waveguide is determined by equation 2. The result is that the phase velocity is $v = 1.39c$. This is the case because the wavelength is modified inside the waveguide.

$$v_p = \frac{\lambda}{T} \tag{1}$$

$$\lambda_w = \frac{\lambda_0}{\sqrt{1 - (\frac{\lambda_0}{2a})^2}} \tag{2}$$

2.

The voltage-standing-wave ratio (VSWR) of different loads is measured.

a.

Assignment 2: Transmission Lines in Time Domain

Part 1: Time Domain Reflectometry: estimate the loads impedance

Z_l can be determined with equation 3. The voltage standing wave ratio is measured as $VSWR = \rho = 0.2$ and our $Z_0 = 50\Omega$

$$\rho = \frac{Z_l - Z_0}{Z_l + Z_0} \tag{3}$$

$$Z_l = -\frac{\rho + 1}{\rho - 1} \cdot Z_0 = 75\Omega \tag{4}$$

Part 2: Dielectric in Coaxial Cable: the Estimation of the Propagation Speed and Relative Permittivity

From the reflections the propagation velocity turned out to be $0.77c$, which is exactly what the datasheet of the cable states[1]. Using equation 5 the relative permittivity ϵ_r can be calculated.

$$v = \frac{c}{\sqrt{\epsilon_r}} = 0.77c \tag{5}$$

$$\epsilon_r = (\frac{c}{v})^2 = 1.69 \tag{6}$$

References

[1] Helmut Singer Elektronik. Sucofles 104. URL http://www.helmut-singer.de/pdf/sucoflex104pb.pdf.