Microwave Memos
Memo 14

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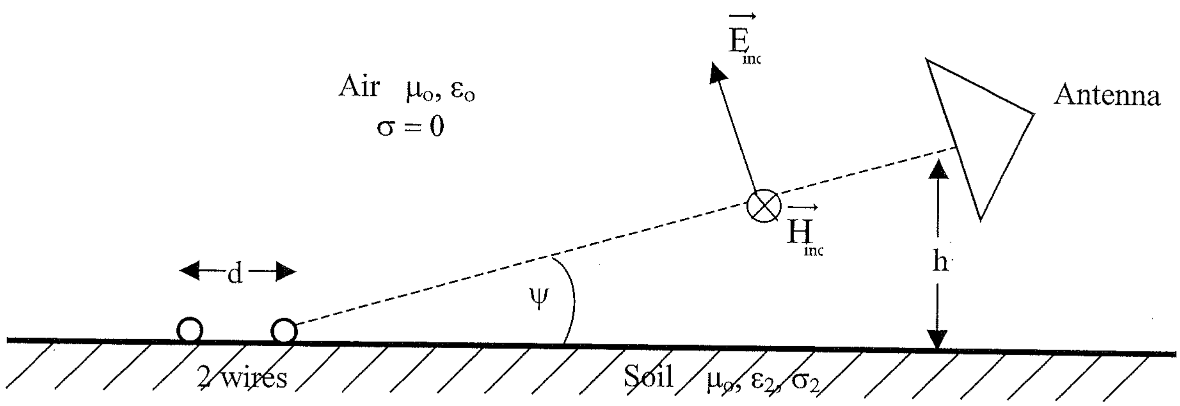
19 November 2003

Vertically Polarized Wave for Exciting Differential Mode of Two Wires on or near the Ground Surface



Consider same approximations as in Microwave Memo 13.

Now, from TN 25, we have:

$$T_e = \frac{E_{tan}}{E_{inc}} = T_h \sin(\psi)$$

$$T_h = 1 + R_h = \frac{2\sin(\psi)}{\sin(\psi) + \frac{1}{\varepsilon_r}\left[1 - \frac{\cos^2(\psi)}{\varepsilon_r}\right]^{1/2}}$$

$$\approx 2\sqrt{\varepsilon_r}\sin(\psi)$$

$$T_e \cong 2\sqrt{\varepsilon_r}\sin^2(\psi)$$

The open circuit voltage between the wires is:

$$V_{oc} = E_{inc} T_e d$$

provided $\lambda/2\pi > d$. If Z_d represents the differential mode impedance (say 100 Ω), then at a port connecting the two wires, say at the end of the wires

$$I_{sc} = \frac{E_{inc}}{Z_d}$$

Appropriate to a low-impedance load.

The energy delivered to the load is about:

$$U \cong \frac{I_{sc}^2}{2} Z_{Load} \Delta t = P \Delta t$$

For numbers with $E_{inc} = 2$ kV/m, h/r = 0.1,

$$I_{sc} = 2 \times 10^3 \times 2\sqrt{10} \times 10^{-2} \times 10^{-1} \times 10^{-2} = 0.13 \text{ A.}$$

With $Z_{Load} = 1\ \Omega$,

$$P = \frac{I_{sc}^2}{2} Z_{Load} \approx 0.8x10^{-2} = 8 \text{ mW}$$

With a pulse width of, say, 20 ns,

$$U \approx 1.6 \times 10^{-10} = 0.16 \text{ nJ.}$$