ECE 4320/5230

TOPIC 11

Ex. 11.3 $L = 1m$, $f = 30MHz$, Let $d = 3m$ (far field)

FCC class B limit: 40 dBμV/m or 100 μV/m

$$100 * 10^{-6} = 6.28 * 10^{-7} \frac{|\hat{I}_{c,net}| (30 * 10^{6})(1)}{3}$$

$$\longrightarrow \hat{I}_{c,net} = 15.92 \, \mu A \equiv 24.04 \, dB\mu A$$

For a current probe with $15 dB\Omega = Z_T$, we measure

$$|V_{SA}|_{dB\mu V} = |I|_{dB\mu A} + |Z_T|_{dB\Omega}$$

$$= 24 + 15 = 39 dB\mu V$$

$$= 89.13 \mu V$$

Thus, if we measure a probe voltage greater than 39 dBμV @ 30 MHz, when we clamp the probe to a 1m cable, the radiated emissions will exceed the limit!

$\Rightarrow$ this means we have to reduce & limit emissions from this cable.

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Ex. 11.5 Cable loss $= \frac{2.5}{100} * 40 = \underline{1\,dB}$

to find the SA voltage reading we use

$$|\hat{I}_{probe}|_{dB\mu A} = |\hat{V}_{SA}|_{dB\mu V} + \text{Cable\_loss}_{dB} - |Z_T|_{dB\Omega}$$

$$\rightarrow |\hat{V}_{SA}|_{dB\mu V} = |\hat{I}_{probe}|_{dB\mu A} - \text{Cable\_loss}_{dB} + |Z_T|_{dB\Omega}$$

$$= 44.4\,dB\mu A - 1 + 15\,dB\Omega$$

$$= 58.4\,dB\mu V$$

This value matches the value on slide 22.

For E-field value,

$$|\hat{E}_c|_{dB\mu V/m} = |\hat{V}_{SA}|_{dB\mu V} + \text{Cable loss}_{dB} - |Z_T|_{dB} + 20\log_{10}(f_{MHz}) + |\hat{F}_{GP}|_{dB} - 13.58$$

$$= 58.4 + 1 - 15 + 20\log_{10}(100) + 0.78 - 13.58$$

$$= 71.6\,dB\mu V/m$$

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Ex 11.6 for the cable $Z_C = \sqrt{\frac{L}{C}}$

$$= \frac{1}{\pi}\sqrt{\frac{\mu_0}{\epsilon_0}}\,\ln\left(\frac{s}{r_w}\right)$$

$$= 120 \ln\left(\frac{s}{r_w}\right) = \underline{288\,\Omega}$$

$\rightsquigarrow$ Both loads are lower than Z_c, thus Low impedance loads.

@ 100 MHz $\rightsquigarrow$ line is $\frac{\lambda_0}{3} = \ell$ $\rightsquigarrow$ short approximation

$$\hat{V}_s \ell = j\omega\mu_0 H_n^i A = j(2\pi * 10^8)(4\pi * 10^{-7})\,\frac{E_i}{\eta_0} * 1 * \underbrace{1.27*10^{-3}}_{\text{50mils}}$$

(120π)

$$= \underline{j\ 26.6\,\text{mV}}$$

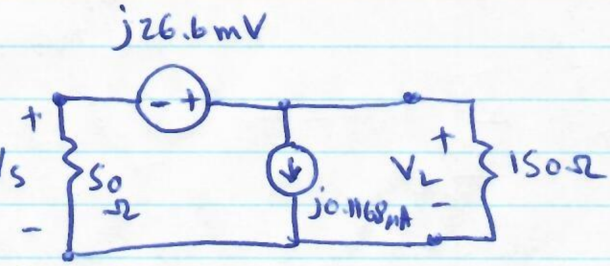
$$\hat{I}_s \ell = j\omega c\, E_t^i\, A$$

$$= j(2\pi\, 10^8)\left(\frac{\pi\,\epsilon_0\epsilon_r}{\ln(s/r_w)}\right) * \overset{(1)}{10} * 1 * 1.27*10^{-3}$$

$$= j(2\pi * 10^8)(14.66 * 10^{-12}) * 1.27 * 10^{-2}$$

$$= \underline{j\ 0.1168\ \text{mA}}$$

The equivalent Circuit is



(note the polarity of voltage source because $\vec{H}^i$ is out of page, opposite to slide condition).

$$\hat{V}_s = -\frac{50}{50+150}(j\,26.6\,mV) - \frac{50*150}{50+150}(j\,0.1168\,mA)$$

$$= -j\,6.65\,(mV) - j\,4.38\,(mV)$$

$$= -j\,11.03\,mV$$

$$\hat{V}_L = \frac{150}{50+150}(j\,26.6\,mV) - \frac{50*150}{50+150}(j\,0.1168\,mA)$$

$$= j\,19.95\,(mV) - j\,4.38\,(mV)$$

$$= j\,15.57\,mV$$