2.3 - The Terminated, Lossless Transmission Line

Reading Assignment: ***pp. 56-63***

We now know that a **lossless** transmission line is **completely** characterized by **real** constants Z_0 and β.

Likewise, the **2 waves** propagating on a transmission line are **completely** characterized by **complex** constants V_0^+ and V_0^-.

Q: *Z_0 and β are determined from L, C, and ω. How do we find V_0^+ and V_0^- ?*

A: Apply **Boundary Conditions**!

Every transmission line has **2** "boundaries"

1) At one end of the transmission line.
2) At the **other** end of the trans line!

Typically, there is a **source** at one end of the line, and a **load** at the other.

→ The purpose of the transmission line is to get power **from** the source, **to** the load!

Let's apply the **load** boundary condition!

HO: THE TERMINATED, LOSSLESS TRANSMISSION LINE

Q: *So, the purpose of the transmission line is to transfer **E.M. energy** from the source to the load. Exactly how much **power** is flowing in the transmission line, and how much is **delivered** to the load?*

A: HO: INCIDENT, REFLECTED, AND ABSORBED POWER

Let's look at several "special" values of **load impedance**, as well as the interesting transmission line behavior they create.

HO: SPECIAL VALUES OF LOAD IMPEDANCE

Q: *So the line impedance at the **end** of a line must be load impedance Z_L (i.e., $Z(z = z_L) = Z_L$); what is the line impedance at the **beginning** of the line (i.e., $Z(z = z_L - \ell) = ?$)?*

A: The **input impedance** !

HO: TRANSMISSION LINE INPUT IMPEDANCE

EXAMPLE: INPUT IMPEDANCE

Q: *For a given Z_L we can determine an equivalent Γ_L. Is there an equivalent Γ_{in} for each Z_{in}?*

A: HO: THE REFLECTION COEFFICIENT TRANSFORMATION

Note that we can **specify** a load with its impedance Z_L or equivalently, its reflection coefficient Γ_L.

Q: *But these are both complex values. Isn't there a way of specifying a load with a real value?*

A: Yes (sort of)! The two most common methods are Return Loss and **VSWR**.

HO: RETURN LOSS AND VSWR

Q: *What happens if our transmission line is terminated by something **other** than a load? Is our transmission line theory **still** valid?*

A: As long as a transmission line is connected to linear devices our theory **is** valid. However, we must be careful to properly apply the **boundary conditions** associated with each linear device!

EXAMPLE: THE TRANSMISSION COEFFICIENT

EXAMPLE: APPLYING BOUNDARY CONDITIONS

EXAMPLE: ANOTHER BOUNDARY CONDITION PROBLEM