5.4 – The Quarter-Wave Transformer

Reading Assignment: ***pp. 240-243***

Yes! This **is** the same quarter wave transformer that we studied **earlier**—but there is **more** for us to learn!

HO: The Quarter-Wave Tansformer-Yet Again

The λ/4 Transformer- Yet Again

Let's go back and **again** look at the **quarter wave transformer**.

This time we will look at it more **critically**, and discover that this matching network has a few **problems**!

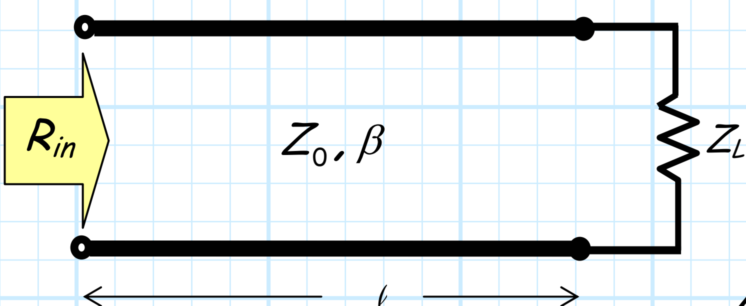
Problem #1

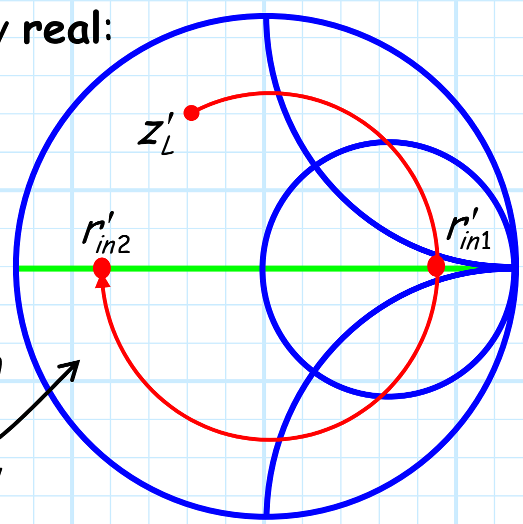
Recall the matching solution was limited to loads that were **purely real**! I.E.:

$Z_L = R_L + j0$

Of course, this is a BIG problem, as most loads will have a **reactive** component!

Fortunately, we have a relatively easy **solution** to this problem, as we can always add some **length** ℓ of transmission line to the load to make the impedance completely **real**:

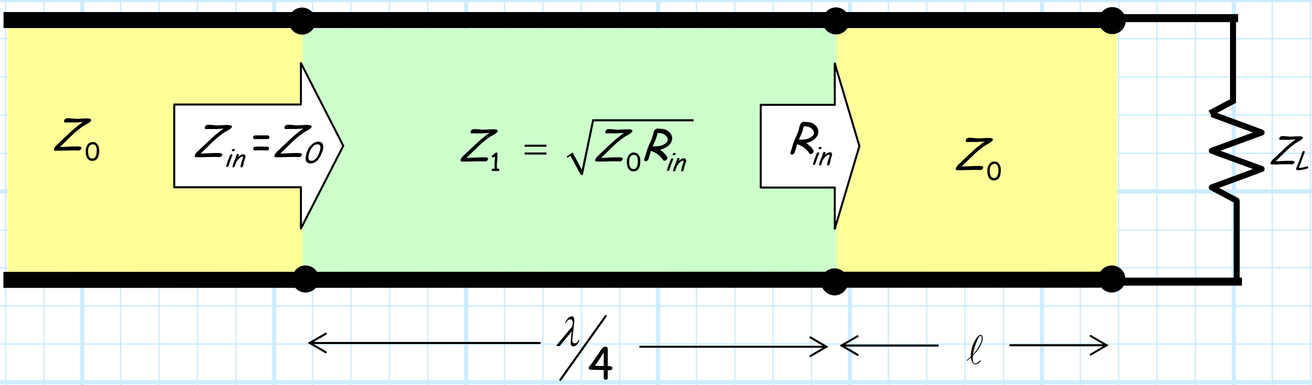




2 possible solutions!

However, remember that the input impedance will be purely real at only **one** frequency!

We can then build a quarter-wave transformer to **match** the line Z_0 to resistance R_{in}:



Again, since the transmission lines are lossless, **all** of the incident power is delivered to the **load** Z_L.

Problem #2

The matching **bandwidth** is **narrow** !

In other words, we obtain a **perfect** match at precisely the frequency where the length of the matching transmission line is a **quarter**-wavelength.

→ But remember, this length can be a quarter-wavelength at just **one** frequency!

As the signal frequency (i.e., wavelength) changes, the **electrical** length of the matching transmission line changes. It will **no longer** be a **quarter** wavelength, and thus we **no longer** will have a **perfect** match.

We find that the **closer** R_L (R_{in}) is to characteristic impedance Z_0, the **wider** the bandwidth of the quarter wavelength transformer.

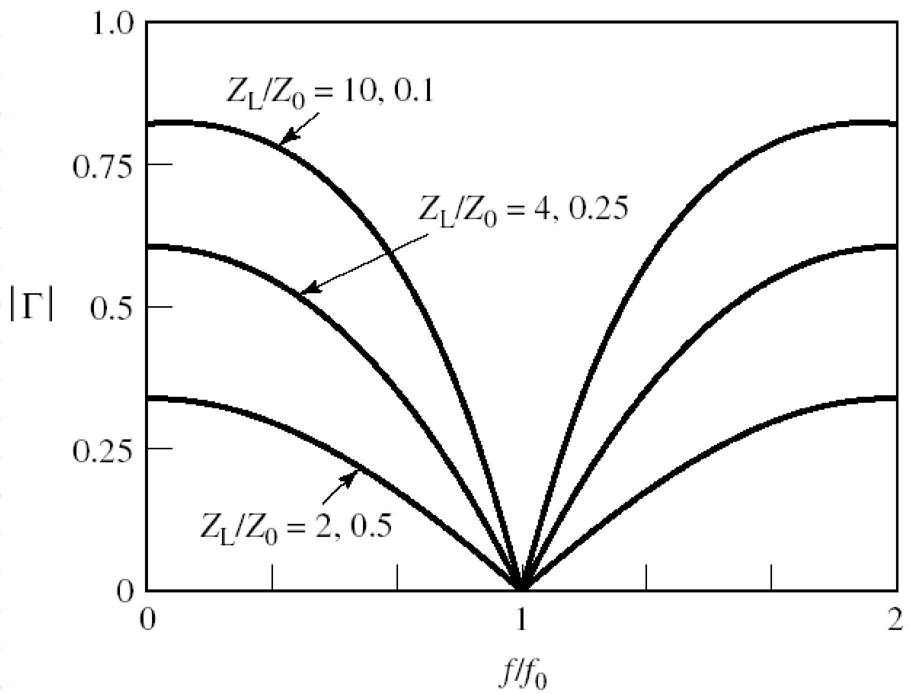


Figure 5.12 (p. 243) *Reflection coefficient magnitude versus frequency for a single-section quarter-wave matching transformer with various load mismatches.*

We will find that the bandwidth can be **increased** by adding **multiple** $\lambda/4$ sections!