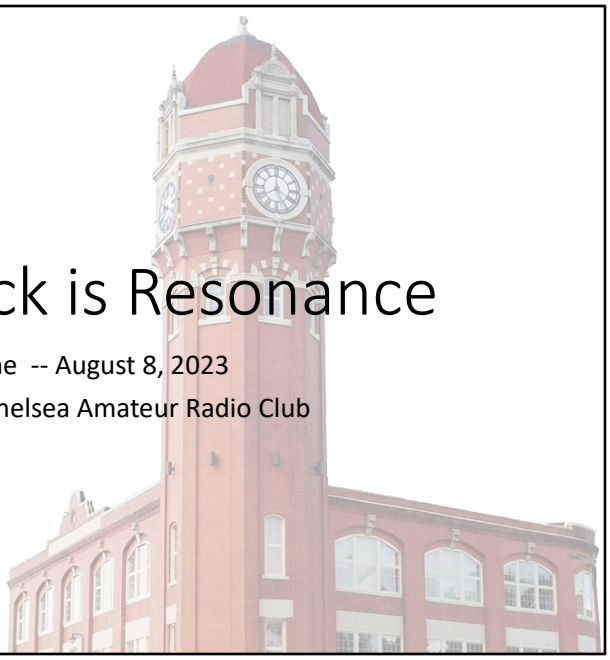
What the Heck is Resonance

Wesley Cardone -- August 8, 2023

Presentation to the Chelsea Amateur Radio Club



Resonance sounds like a fancy term but it happens when reactances are equal. But what are reactances. For that matter, what are resistances.

Electrical Nomenclature

- Fortunately for us, most electrical terminology derives from the English language.
- Everything else comes from people's names, inventors recognized by the electrical industry for their lifetime accomplishments.

Fortunately for us, virtually all electrical nomenclature comes from common-sense English terminology. You've probably heard terminology such as permittivity, admittance, and the list goes on. Some others come from inventor's names such as Oerstead. You are just going to have to live with those.

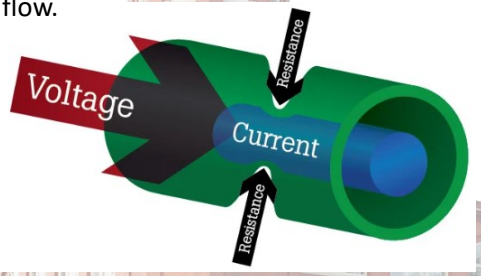
But First…"What is a Resistance?"

- The name "resistance" implies that
  - something is being held back
  - "…an 'impediment' in the road."
  - The French patriots giving problems for the Nazis
  - Etc.

Why did the French patriots during the occupation of France in world-war II call themselves "the resistance." Maybe they were all hyped up by the inventions of Marconi and his radio inventions that they thought of themselves as electrical resistors of 1 Watt, 5 Watts and so on. I don't think so.

Resistance

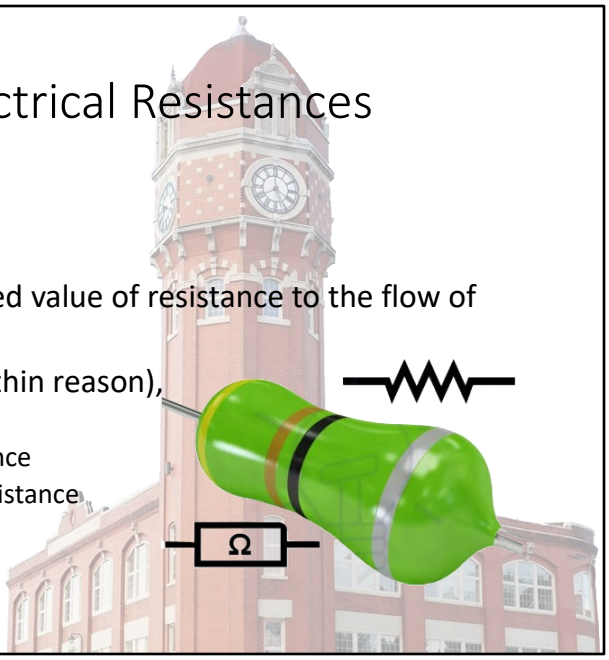
- Resistance is the act of “putting the squeeze” on current flow.
  - The higher the resistance, the less current flow (assuming same Voltage)
- We also call a “Voltage” a “potential.” Why is that?
  - Voltage is the “push” behind current flow.



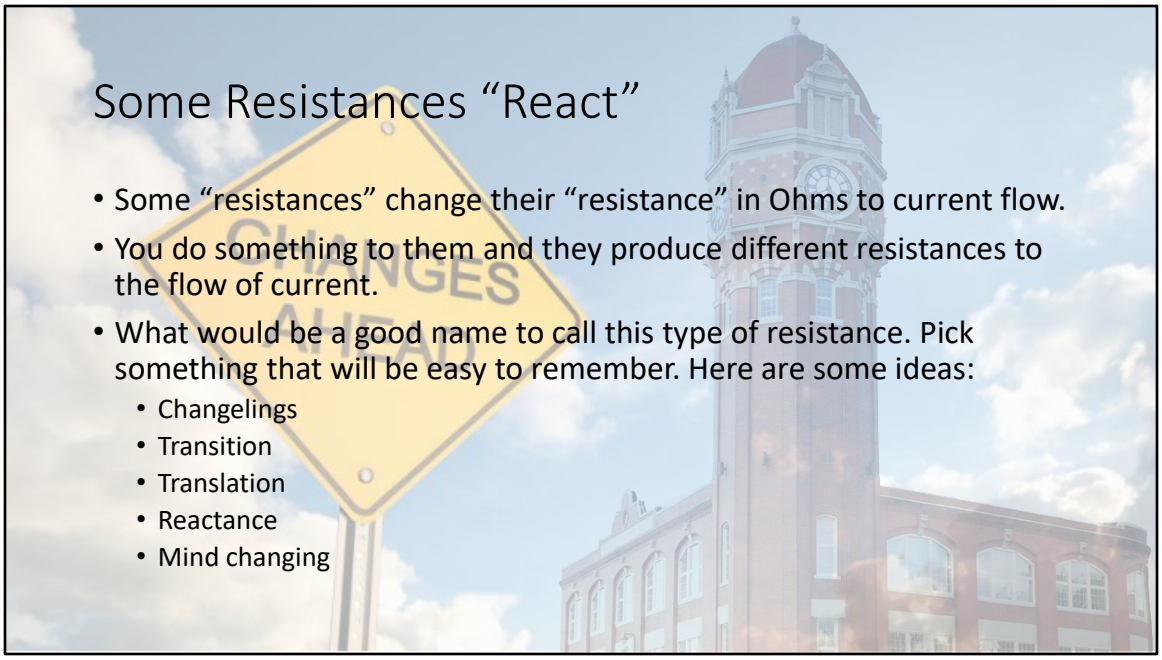
So, resistance is putting the squeeze on current flow. But this brings up another topic. What about Voltage. Did you know that Voltage is a type of “potential?” Why do they call it a potential? By the way, Volts is one of those terms that came from somebody’s name. That is why it appears here as a proper name.

Different Types of Electrical Resistances

- The “Resistor” resistance
- It is like a bump on a log.
- Except for parasitics, it is a named value of resistance to the flow of current.
- No matter what you do to it (within reason), it does not “react.”
  - Give it DC—no changes to resistance
  - Give iut AC—no changes to its resistance
- Resistors are valued by the Ohm



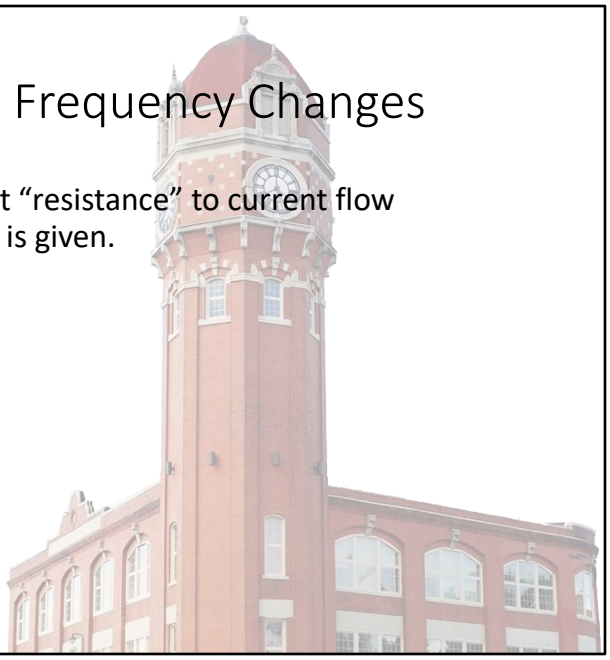
But did you know that there are different types of electrical resistance? Our famous resistors acts like a bump on a log. You can throw it across the room and its resistance doesn’t change (assuming it doesn’t break). You can give it DC potential and its resistance stays the same and you can give it AC potential and there are still no changes.



But there are some types of resistances that “react” to what you do to them.

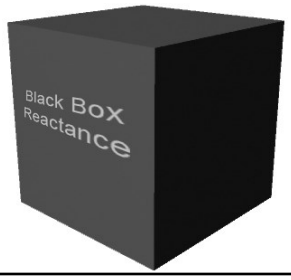
Reactances “react” to Frequency Changes

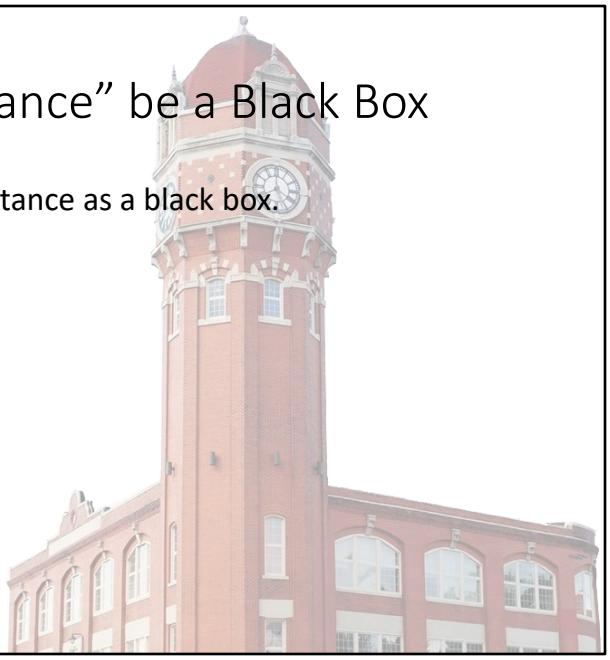
- A “reactance” produces different “resistance” to current flow depending on what frequency it is given.



For Now, Let a “Reactance” be a Black Box

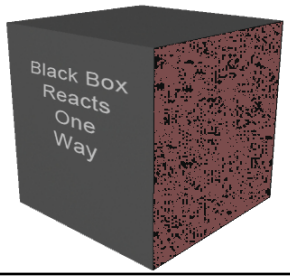
- Just for now, let’s think of a reactance as a black box.





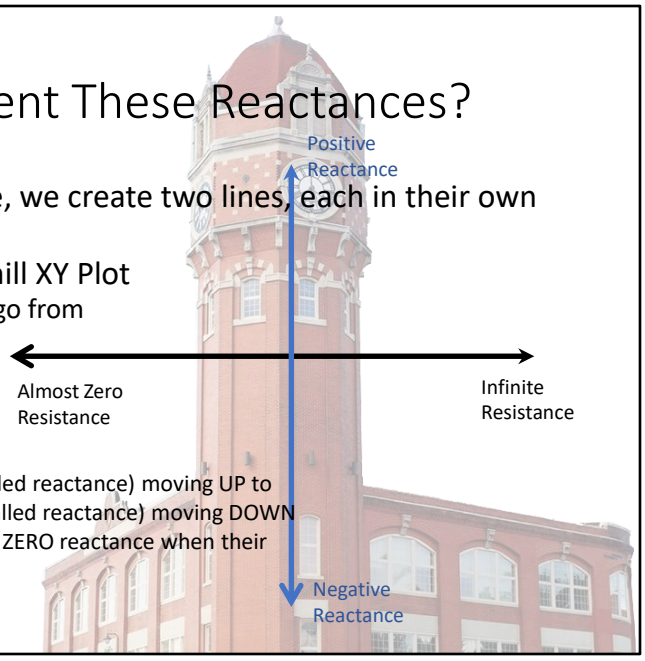
There are 2 Kinds of Reactance

- One black box can go from zero “resistance” (reactance) to
  - POSITIVE infinity
- The other black box can go from zero “resistance (reactance) to
  - NEGATIVE infinity.

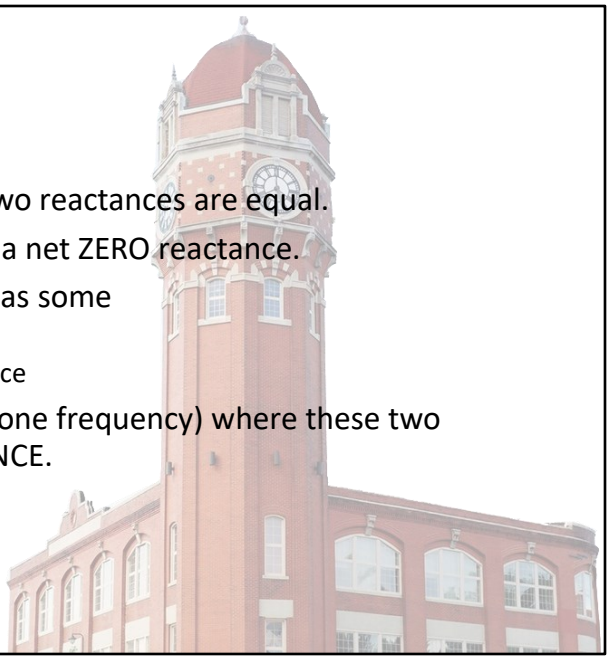


How Do You Represent These Reactances?

- In order to keep things simple, we create two lines, each in their own plane.
- It's an every-day, run of the mill XY Plot
  - Resistance on the X plane can go from
    - Almost zero (but NOT zero) on the far left to
    - Infinity on the far right
  - "REACTANCE" on the Y plane can go from
    - Positive infinity "resistance" (called reactance) moving UP to
    - Negative infinity "resistance" (called reactance) moving DOWN
    - They cancel each other for a net ZERO reactance when their sums are equal.



Resonance



- Resonance happens when the two reactances are equal.
- When equal they cancel leaving a net ZERO reactance.
- Your antenna has reactance. It has some
  - Of one kind of reactance and
  - Some of the other kind of reactance
- There is a frequency (and **ONLY** one frequency) where these two reactances are equal—RESONANCE.