Basic Antennas Part 1

Transmission Lines and their Properties

Transmission Lines

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Baluns: Choosing the Correct Balun

By Tom, W8JI

Transmission Lines

- What is a Transmission Line?
  - Simply, a set of conductors used for transporting radio frequency or other electrical signals
  - Transmission lines are used to carry radio frequency signals to and from the antenna, or between pieces of equipment

Transmission Lines

- Examples
  - Coax or Coaxial Cables: consists of an insulated center conductor surrounded by a flexible copper shield (braid); often enclosed in a protective jacket
  - Twin-lead or Open-wire Lines: mostly used for HF; twin-lead is comprised of two parallel wires encased in a protective jacket, open-wire line is generally made from two parallel, non-insulated wires, separated by spacers

Transmission Lines

- Shielded vs. Unshielded Cables
  - Shielded cables such as coaxial cables will be more immune to electrical interference than unshielded lines
  - Shielded cables are not effected by objects in close proximity
  - Open-wire lines are immune to long-term water damage, but may suffer impedance changes or increased loss when wet
  - Shielded cables can be buried

Transmission Lines

- Shielded vs. Unshielded Cables
  - Coaxial cable may be damaged by water intrusion
  - Parallel conductor lines may be better for feeding high-impedance loads
  - Coaxial cables are manufactured with a 50 ohm impedance, matching most transceivers perfectly
  - Most parallel conductor lines have characteristic impedances of several hundred ohms or more

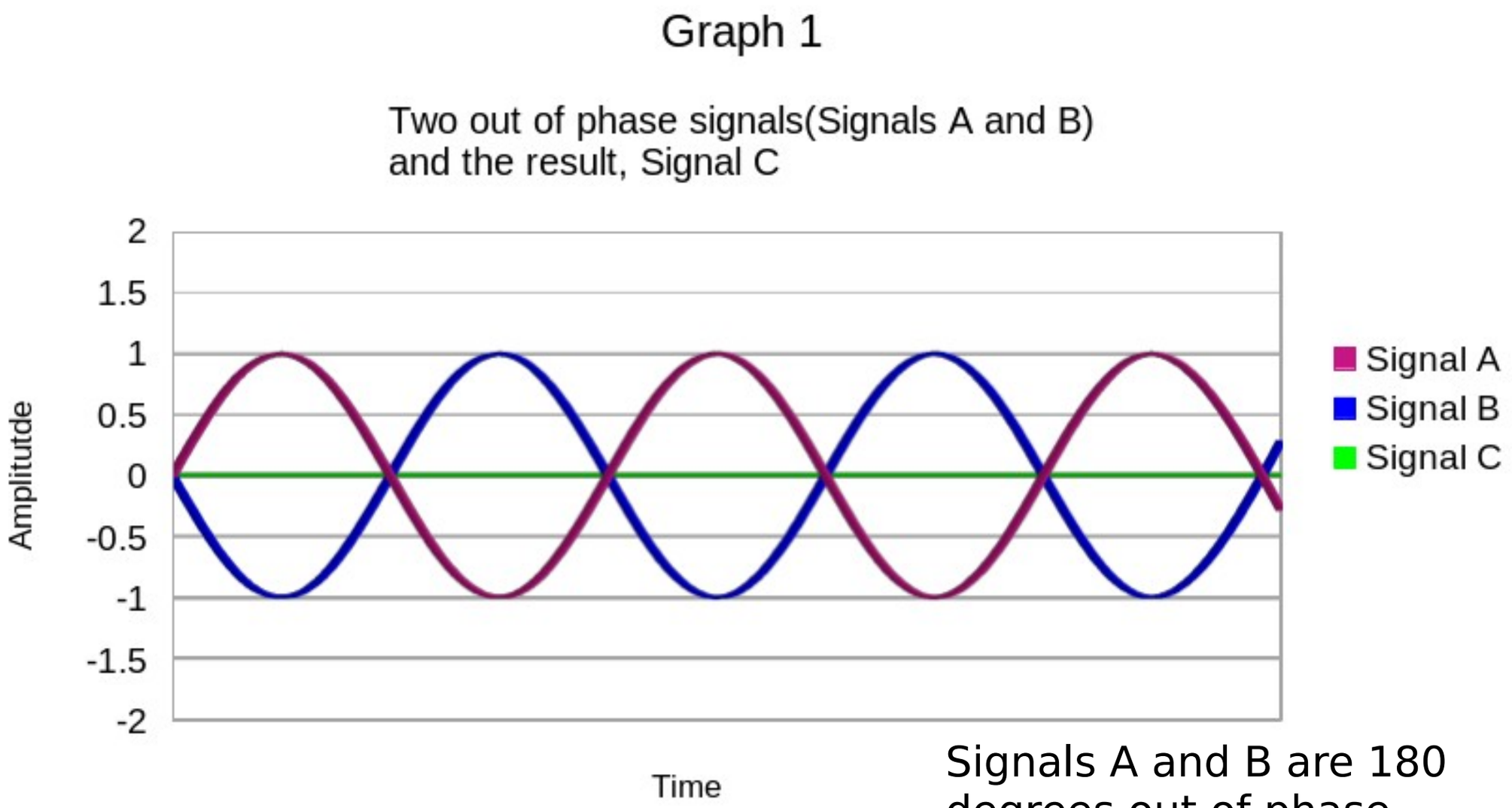
Transmission Lines

- Transmission Line vs. Antenna
  - Any single conductor (wire) will radiate the signal it is carrying (like an antenna should)
  - Two lines carrying exactly opposite currents (signals) in close proximity will cancel the radiation of the other line, resulting in no net (effective) radiation
  - A shielded line may also be used to avoid feed line radiation

Transmission Lines

- What Makes a Balanced Transmission Line
  - Parallel conductor lines are balanced relative to ground: both conductors must have equal but opposite voltages and currents on each conductor
    - Both conductors MUST be balanced in this way to avoid radiation
    - “Opposite” means equal amplitude, 180 degrees out of phase
    - There is an EM field around each conductor which is canceled by the other—IF IT IS INDEED BALANCED!

Transmission Lines



Signals A and B are 180 degrees out of phase

Transmission Lines

- What Makes a Balanced Transmission Line
  - Coaxial cables are unbalanced because the outer shield is at ground potential—and must be so
    - Parallel conductor lines will not work under such a condition
    - The current balance needed takes place within the center insulation(dielectric)
    - The currents will cancel out if properly terminated
    - All of the voltage and current in a properly terminated coaxial cable is contained in the shield—either one on the outside would be a problem

Transmission Lines

- The Results
  - A coaxial cable will not radiate *provided* it is terminated correctly
  - Twin-lead transmission lines will not radiate if they are connected to BOTH balanced loads and generators
  - Remember: In-phase signals add themselves together, out-of-phase signals subtract themselves, just like in Graph 1

Questions? Comments?

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