Introduction to Ham Radio Antennas and Feed Lines

Agenda

- The Best Antenna You Can Have
- Resonate vs Non-Resonate Antennas
- Types of Antennas
- How to Calculate Dipole Antenna Lengths
- Understanding Feed Lines, Chokes, Baluns, and Ununs
- Questions

So, What is The Absolute Best Antenna???

- **The Absolute Best Antenna is the one you have and can put up!!**

Basic Types of Amateur Radio Antennas

How Antennas Work

- Antennas work by converting electrical signals into electromagnetic waves for transmission and vice versa for reception. When an electric current flows through the antenna, it generates radio waves that travel through the air, and when radio waves hit an antenna, they induce a small electrical current that can be processed by a receiver.

Resonant vs Non-Resonant Antennas

Resonant Antenna

Resonant antennas are tuned for a specific frequency, ensuring efficient operation and maximum power transfer in targeted applications.

Non-Resonant Antennas

Non-resonant antennas function across a wide frequency range but may need impedance matching devices (antenna tuners) for optimal efficiency in various uses. FYI, no such thing as an antenna tuner…….

Basic Ham Antennas

- **Dipole** - A dipole antenna is a simple type of antenna consisting of two conductive elements, typically wires, that are oriented end-to-end. It is widely used in armature radio and telecommunications for its effective radiation pattern and ease of construction.
- **Off-Center-Fed (OCF) -** OCF antennas are a type of dipole antenna where the feed point is not located at the center. This design allows for better performance across multiple amateur radio frequency bands.
- **End-Fed Dipole -** An end-fed antenna is a type of radio antenna that is fed at one end rather than the center, making it simpler to construct and often more portable. It is popular among amateur radio operators for its ease of use and effectiveness across multiple bands.

Basic Ham Antennas

- **Vertical Antennas -** Vertical antennas are popular among amateur radio operators, especially those with limited space. They are designed to take up minimal horizontal space while providing effective communication capabilities.
- **Loop Antenna-** A loop antenna is a type of radio antenna made from a loop or coil of wire that can be used for both transmitting and receiving radio signals. They come in various sizes and shapes, with large loop antennas being more efficient for transmission and small loop antennas often used for receiving signals.
- **Yagi Antenna -** A Yagi antenna is a type of directional antenna that consists of a driven element, a reflector, and one or more directors.

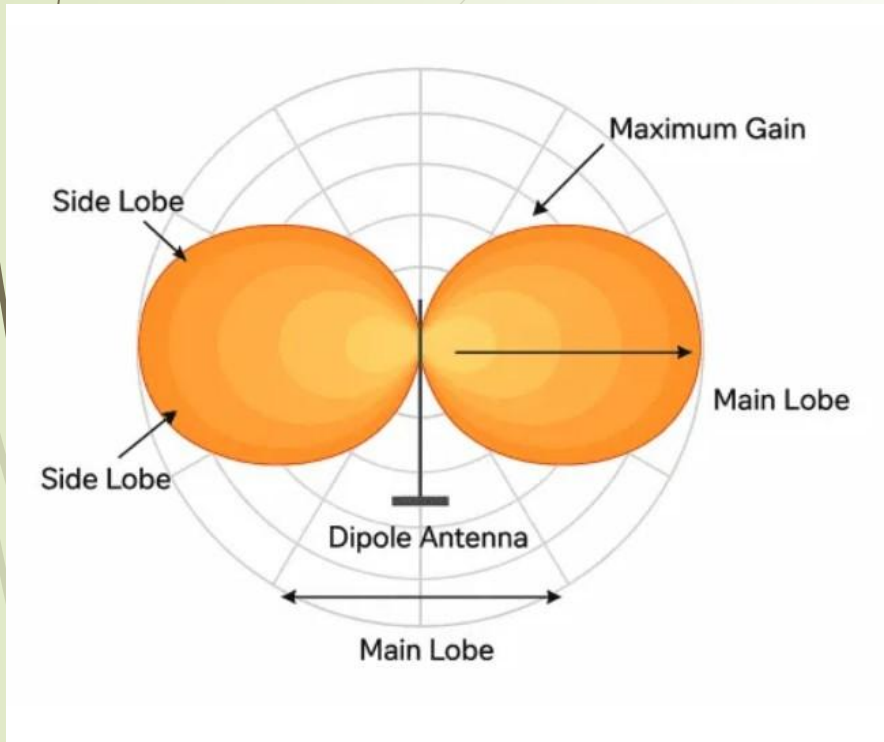
A quick overview of antenna impedance, SWR, Gain, and Radiation Pattern

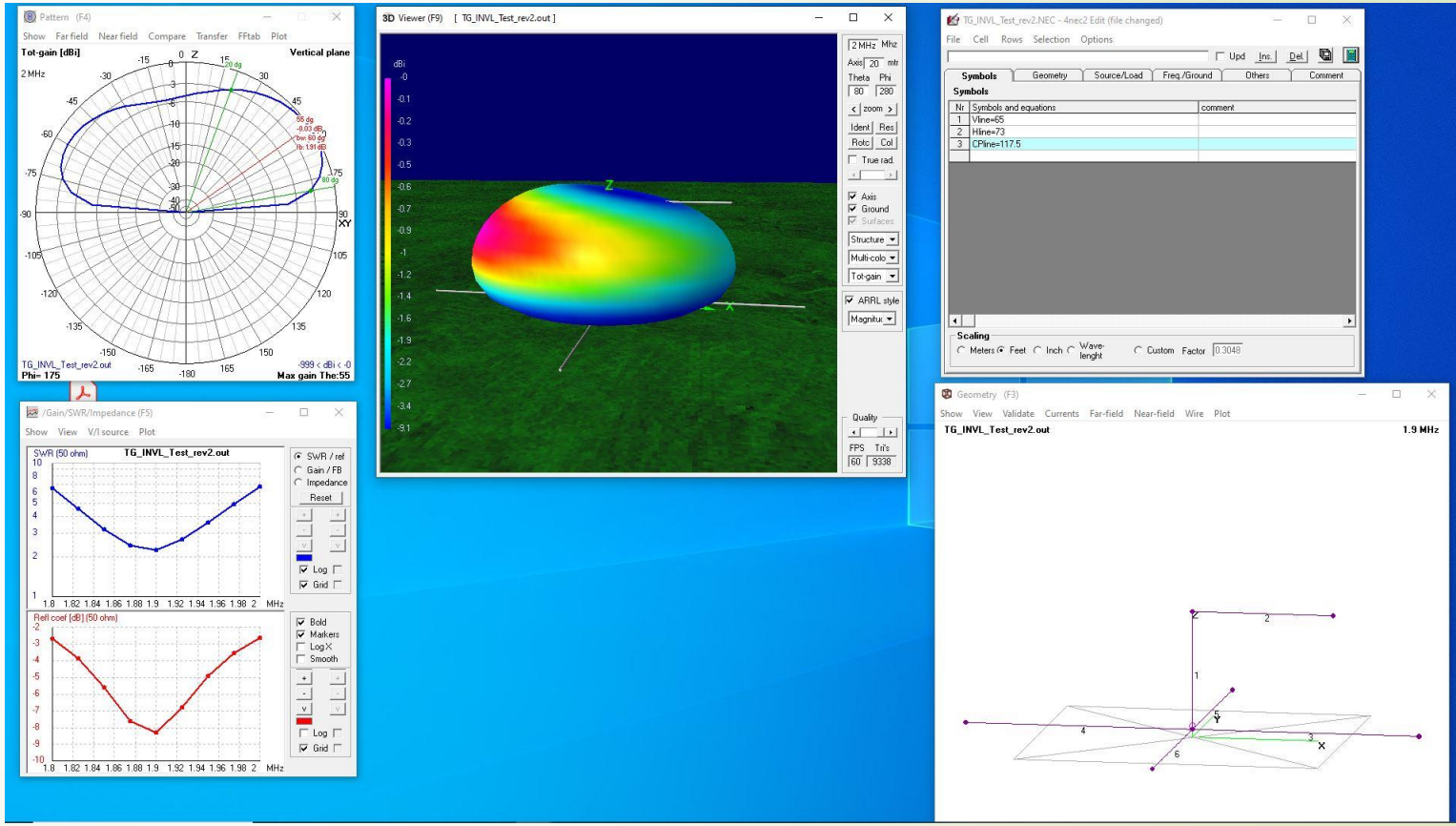
- The impedance refers to the opposition to the flow of alternating current in an antenna, which varies based on its length and feed point position. A typical half-wave dipole has an impedance of around 73 ohms not 50 ohms. A resonant dipole antenna will have an SWR of about 1.3:1 not 1:1.
- The impedance will change depending on the distance to the ground and configuration such as inverted V, sloping, and length.
- Standing Wave Ratio, SWR is the results of impedance mismatch.
- SWR is **not** an indication of how well the antenna will work.

A quick overview of antenna impedance, SWR, Gain, and Radiation Pattern

- **Antenna gain** refers to how effectively an antenna converts input power into radio waves in a specific direction. It combines both directivity and efficiency.
- **Dipole antennas** typically offer a gain of **2.15 dBi** in free space (ideal conditions), equivalent to **0 dBd** (gain compared to a reference dipole).
- **dBi** Decibels relative to an isotropic radiator (theoretical point source)
- **dBd** Decibels relative to a standard half-wave dipole
- A **dipole antenna's gain is 0 dBd**, which equals **2.15 dBi**. Most manufacturers specify gain in dBi to make antennas appear more powerful, so always check what unit is being used.

A quick overview of antenna impedance, SWR, Gain, and Radiation Pattern





Calculating the Length for a Dipole Antenna

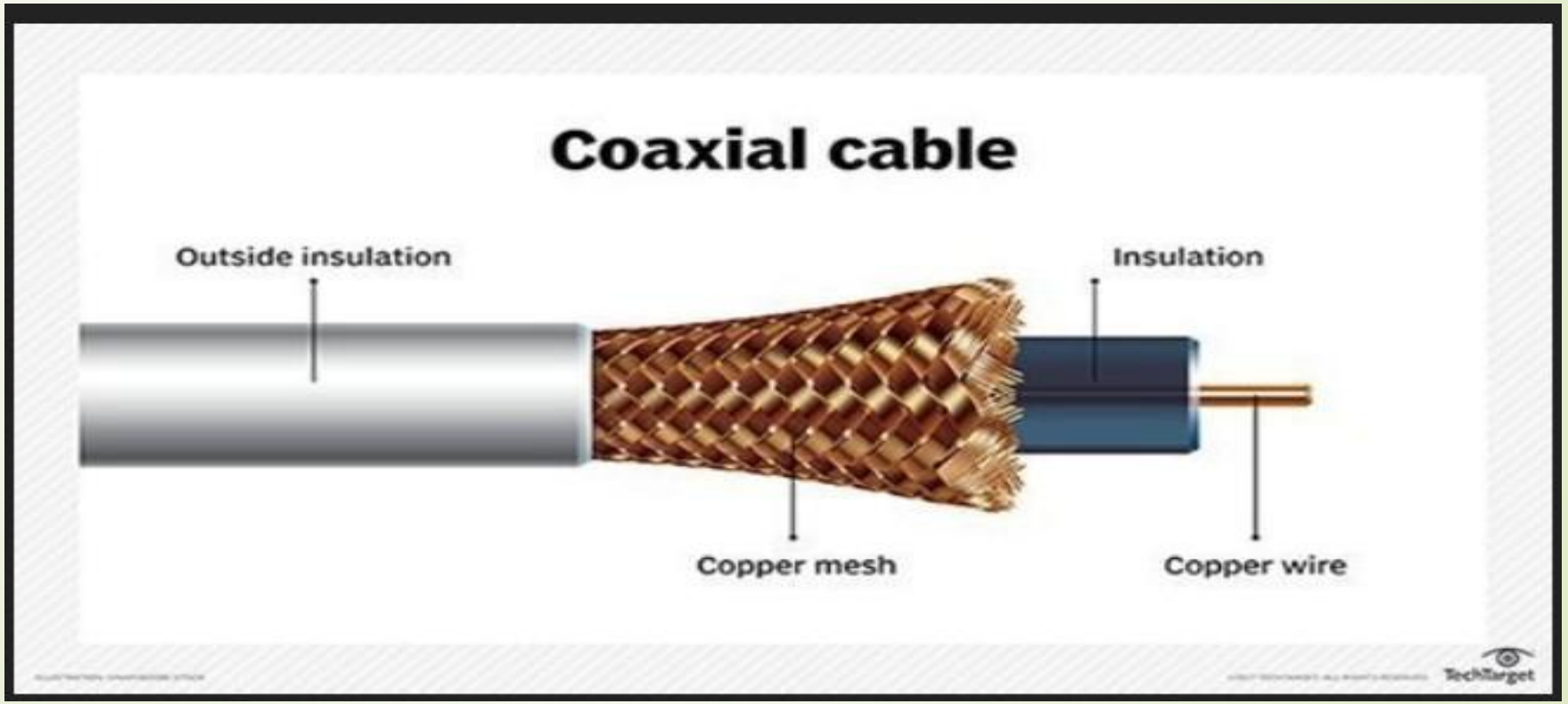
- Dipole Length in Feet = **468/Frequency In MHz**. For meters use 143.
- Example: Calculate the length for a dipole for the middle of the 20 Meter band for a General operator.
- The middle of the 20 Meter band for the General operator is 14.2875 MHz.
- Divide 468 by 14.2875 which equals 32.75 feet. Each leg will be 32.75 feet divided by two which equals 16.38 feet.
- Here is a spreadsheet I created to calculate dipole lengths. C:\Users\Owner\Desktop\Antenna Calculator

Types and Purpose of the Feedline

- A feedline or transmission line is essentially a two-wire cable connecting the transmitter/receiver parts of a wireless system to the antenna. Its primary purpose is to efficiently carry RF (Radio Frequency) energy from one end to the other.

Coax Cable

- Coaxial cable is a type of electrical cable that consists of an inner conductor surrounded by an insulating layer, a metal shield, and an outer insulating layer.

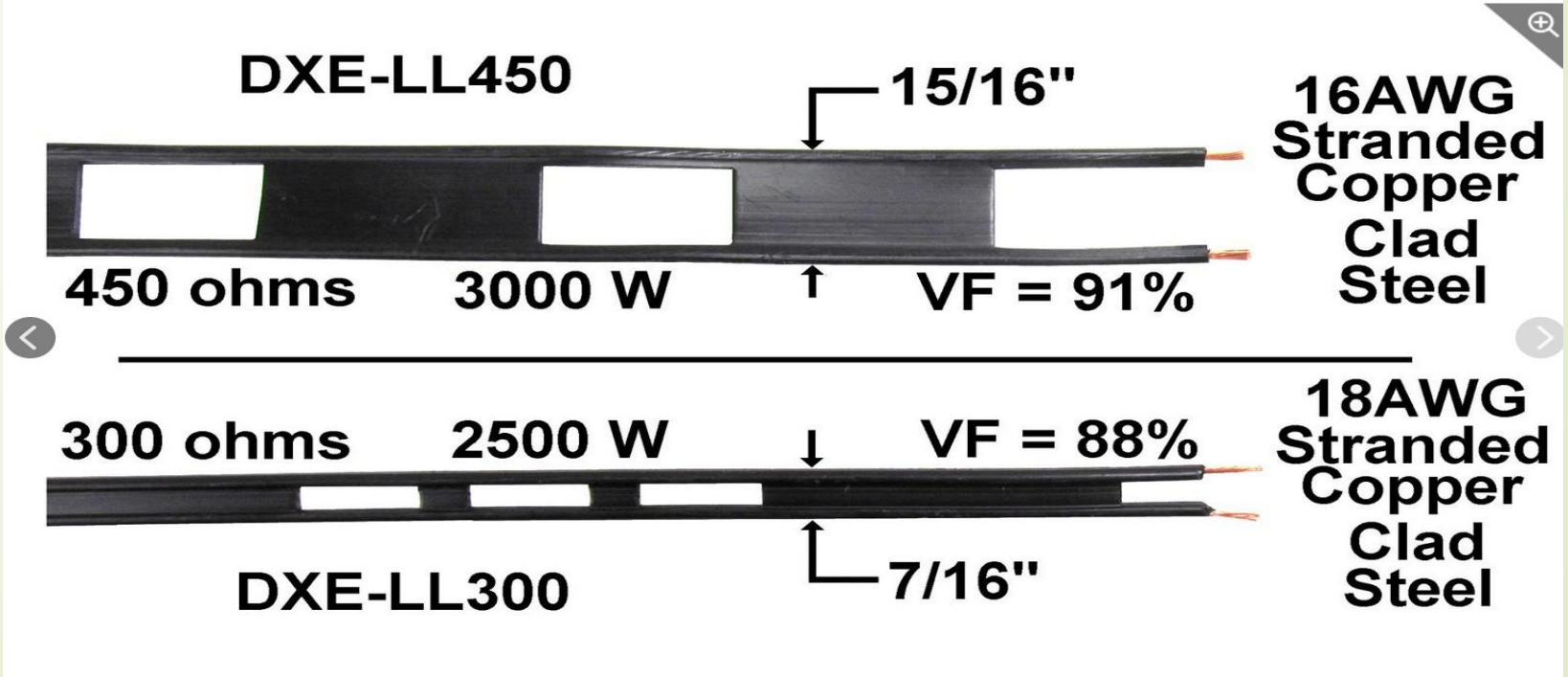


Types of Coax Cable

- Coaxial cable is considered **unbalanced** because it has a central conductor surrounded by a cylindrical shield, which creates unequal impedances between the conductors and ground.
- **50 Ohm coaxial cable** is designed to carry high-frequency signals with low loss, commonly used in applications like telecommunications and broadcasting.
- **75 Ohm coaxial cable** is a type of electrical cable designed for high-frequency signal transmission, commonly used in video and audio applications. It has a characteristic impedance of 75 Ohms, which helps minimize signal loss and allows for efficient energy transfer over longer distances.

Balanced Feed Line

- A balanced feed line is a type of transmission line that consists of two parallel conductors, which carry equal and opposite currents, minimizing electromagnetic interference and signal loss. It is commonly used in radio communications, particularly for feeding balanced antennas, and can provide better performance compared to unbalanced lines like coaxial cables.



Balanced Feedline vs Un-Balanced Feedline

- The key characteristic of a balanced line is that the **same amount of current flows in each wire with respect to ground.** The current in one wire is 180 degrees out of phase with the current in the other wire. In a balanced line, **neither of the wires is connected to the ground.**
- Coaxial cable is unbalanced because the current in the center conductor is referenced to the braid. The braid conductor is connected to the ground.
- Balanced feedlines, like ladder line, are more efficient but are more affected by nearby metal objects. It can handle high voltage standing wave ratios (VSWR) better, making them ideal for multi-band operations.
- Unbalanced feedlines, such as coaxial cable, are more common because it is less affected by nearby metal objects but can experience higher losses in high VSWR conditions. It has better shielding which keeps RF from leaking out.
- https://www.qsl.net/co8tw/Coax_Calculator.htm

Chokes, Baluns, and Ununs

Chokes

- A coax choke, also known as a common mode choke, is a device used to prevent unwanted radio frequency (RF) currents from flowing along the outer shield of a coaxial cable, which can cause interference and safety issues. It helps improve the performance of radio equipment by isolating the coax from the antenna system.

Balun

- Balun is short for "balanced to unbalanced"
- A balun is an electrical device that converts between balanced and unbalanced signals, allowing different types of transmission lines to connect without disrupting their impedance.
- Baluns can also be used to transform impedances.
- **There are two main types of baluns:**
- **Current baluns (Guanella)** → Enforce equal currents, suppress common-mode currents.
- **Voltage baluns (Ruthroff)** → Enforce equal voltages but do **not** suppress common-mode currents.

Ununs

- Unun is short for un-balanced to un-balanced
- UNUN is a transformer is used to match impedance between an unbalanced antenna and an unbalanced feedline (coax), improving efficiency and reducing losses.
- Typically used to match End-Fed, Off-Center Fed, and vertical antennas.
- The most typical ununs are 4:1, 9:1, and 49:1.

Questions?