Ham 120 – Return

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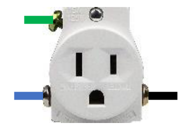
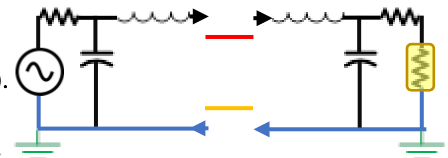
1. Why is every antenna installation unique? Why does an antenna that works one place not work in another? Why is distance from the earth so important?



2. Start at the coax connector. How many conductors do you see? What is their significance?
   a. Look at the normal electrical receptacle. How many conductors do you see? What are they?
   b. Consider an electrical circuit. Relax. You already know this, even if not in this form.
   c. Black = energized, hot; white/blue/shield = return, neutral; green = ground, earth.
3. Both circuits are *AC* (alternating current). The power receptacle is 60 Hz and the RF coax is MHz.
   a. Energy travels on the energized hot side. It returns on the neutral.
   b. Unbalance and noise travels on ground.

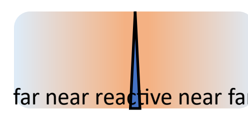


4. In the electrical panel, neutral connects to ground (earth).
   a. At the single point ground *(SPG),* the coax shield connects to ground (earth).
   b. The return and ground are parallel paths.
   c. Different impedance with frequency causes a split of very different currents.
   d. Under no circumstance may the local return / neutral connect to earth at more than one point.
   e. Otherwise, return current will flow uncontrolled in earth or in neutral.
5. Look at the sketch of the source (transmitter on left) connected to the load (receiver on right).
   a. Each end sees an equivalent impedance of a resistor *(R)*, inductor *(L)*, and capacitor *(C)*.
   b. As a power circuit, load is the receptacle. The red wire connects the hot and the brass connects the return.
   c. AS a RF circuit, load is the receiver. No wire connects. The electrical-magnetic *(E-M)* energy moves through air.
6. Earth is the great source from which energy is pumped and the great sink where all energy returns.
   a. Earth is the balance, stabilizer, and foundation. Nevertheless, no two earth points have the same characteristics.
   b. Wet soil is very conductive while rock and sand are insulators.
   c. The antenna system should be physically grounded, but this will impact the return.

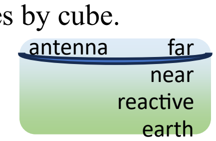
$f = 1/ 2\pi \sqrt{L C}$

$f(MHz)\ \lambda = 300$

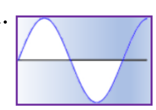
7. Frequency is how often something vibrates. RF is measured in *MHz* (million cycles per second).
   a. The frequency is created by the inductor *(L)* from wire bends and the capacitor *(C)* from being close.
   b. One frequency can be from many combinations of *L* and *C*. Nature gives more than one way to get there.
   c. Frequency *(f)* times wavelength *(λ)* is the speed of light *(c)*, 300 million meters/second.
   d. So, frequency, wavelength, capacitance, and inductance are tightly interrelated with light.



8. Since the *E-M* is in space, not a wire, the voltage spreads-out creating a field.
   a. You already know this. If you are close, the signal is strong. In far field, there is little effect.
   b. Field strength from an antenna depends on distances measured using wavelength.
   c. *Reactive* near field is closer than 0.16λ, *near* field is less than 1λ, *transition* zone, *far* field is further than 2λ.
   d. Field *intensity* declines linearly with distance. Field *density* weakens by square. *Energy* decreases by cube.
   e. Double distance (2x) makes half (1/2) intensity, one-fourth (1/4) density, and one-eighth energy.



9. Height is critical. More height increases gain. Height into the far field gets out of ground-effect.
   a. Earth absorbs energy. Getting height out of ground-effect is easy with UHF, not with HF.
   b. At UHF frequency = 430 MHz, wave = 70 cm or 2.3 feet. Mounting antenna at 2λ = 4.6 ft is out of ground effect.
   c. At HF frequency = 15 MHz, wave = 20 m or 66 ft. Mounting antenna at 2λ = 132 feet is not practical.



10. Return is the second side of an electrical circuit. An antenna system has a return, intentionally or not.
    a. The antenna is effectively one-half wavelength long with any combination of a radiator and return.
    b. Because of field effects along with stray and coupling impedances, lengths may appear shorter.
    c. Returns are called dipole, radials, or counterpoise depending on their connection to the radiator.

$X_L = 2\pi f L$

$X_C = 1/ 2\pi f C$

$X_L = X_C$

$Z_0 = R$

11. Why quarter-wave antenna? The common size is simple, requiring no analysis. It is half of half-wave.
    a. Better performance for gain, multi-band, and take-off angle comes with other arrangements.
12. Impedance *(Z)* is the sum of the effects of resistance, inductance, and capacitance.
    a. Inductance with frequency is inductive reactance (X_L). Capacitance with frequency is capacitive reactance (X_C).
    b. Resonance is inductive reactance equal to capacitive reactance, which cancel. So, only resistance remains.
13. Look at the circuit diagram again. The objective is to match the impedance on both sides.
    a. If they do not match, the SWR increases from 1:1, resulting in heat.
    b. The geometric relationship of radiator and return determine polarization and take off angle.
    c. Fine Print Note: We realize your effort. Now you know antennas.
14. Life is good. Enjoy!