Microvolt

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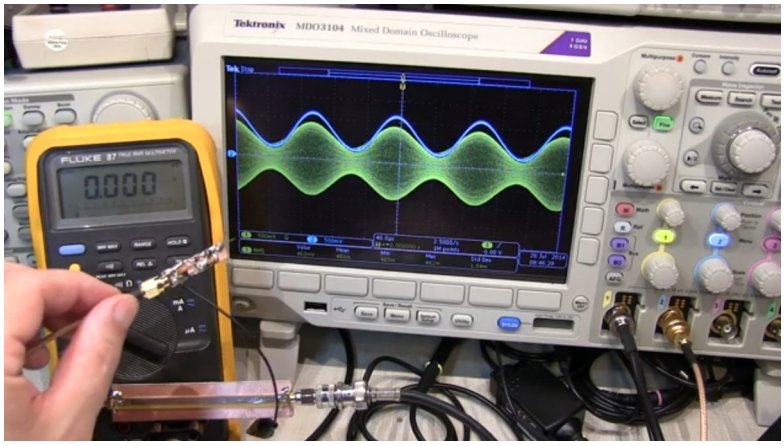

RF (radio frequency)

While many tend to think of *RF* only as a radiation type that travels through the air, RF actually refers to *radio frequency* signals of all types. The two that most directly relate to amateur radio are electrical RF (high-frequency electricity) in wires, also known as *AC* (alternating current), and electromagnetic RF in space, also known as *radio waves*. Let's lump the rest into the generalization of radio. Whether in the air or connected by wires, RF behaves unlike the more familiar DC (direct current) we're used to. Time to explore the relevance of the RF world.

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Cover – RF (radio frequency)

The study discipline involving RF can be categorized as ***radio engineering***, but actually involves many discrete fields, no pun intended. Their common understanding is the application of electrical and electromagnetic signals at radio frequencies. The spread of frequencies regarded as RF are not officially set, yet are generally agreed upon by industry and usage. Typically, the range for most RF references is 3 kHz through 300 GHz, although other conventions are common.

Electrical RF

In electronic circuitry, RF demands specialized knowledge of alternating current using frequencies that behave according to rules beyond those of direct current electricity. For example, AC circuits must be developed with not only resistance in mind, but impedance, which includes both resistance and reactance.

When designing PCBs (printed circuit boards) and other electronic circuitry for RF purposes, care must often be taken to prevent unwanted interconnections between components. At radio frequencies a pair of wires can become an unintentional inductor, even a transformer. Because of the material between the wires, they can also turn into an unintentional capacitor. And if they become both (quite common), they can create unwanted oscillations. Finally, the oscillations can make the PCB an effective antenna, emitting unwanted radio signals where they don't belong.

Another property that's unique to the RF world is the intersection between electrical RF and radio waves, one of which is known as coupling, which both blesses and plagues engineers world-wide. In fact, coupling is what enables an ordinary wire to "capture" a radio signal and transform it into AC that is then processed by a radio receiver. An example of the undesirable behavior of coupling is ***crossover***, which has plagued computer designers for decades, due to the GHz frequencies of their CPUs and other ICs (integrated circuits).

Electromagnetic RF

Radio waves are ***electromagnetic radiation*** of frequencies within the RF spectrum. They're a perpendicular set of oscillating fields that propagate close to the speed of light, depending on the medium. Speaking of which, radio waves are unique in that they require no medium through which to travel or propagate because *they are* their own medium.

Electromagnetic RF is invisible and can penetrate most non-conductive things, depending on the frequency and densities of the materials through which it's attempting to pass. It can reflect off conductive surfaces and refract off the charged particles way up in the sky. While the atmosphere is largely transparent to visible light, also a type of electromagnetic radiation, its ionosphere can refract (bend) radio waves back to Earth. Finally, it can both interfere with itself and enhance itself.

Would you stand next to your sandwich in the same microwave oven? This photo was taken in 1933 at the Chicago World's Fair by Westinghouse to demonstrate both the effectiveness and safety of heating by radio waves. Yikes.

Besides amateur radio, an example of a useful RF application is the microwave oven. Indeed, most of these household devices use magnetrons that emit a kilowatt or more of radio waves at 2.45 GHz (12 cm band, same as that for Wi-Fi). That particular frequency was selected because it was demonstrated experimentally to be a "sweet-spot" balance for exciting the molecules of water, most fats, and many common sugars. Today, 2.45 GHZ is "allocated" to microwave ovens by the ISM (Industry, Scientific, and Medical) band plan.

Microvolt editorial staff